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A REPORT ON THE EXAMINATION OF THE WASTE TREATMENT AND DISPOSAL OPERATIONS AT THE NATIONAL REACTOR TESTING STATION, IDAHO FALLS, IDAHO

Federal Water Pollution Control Administration
Portland, Oregon

October 1969

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United States Department of the Interior
Federal Water Pollution Control Administration, Northwest Region
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In Cooperation with
The Idaho Department of Health
Statehouse
Boise, Idaho 83707

October 1969

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I. INTRODUCTION

Purpose and Nature of the Examination

Representatives of the Federal Water Pollution Control Administration and the Idaho Department of Health made an examination of the waste treatment and disposal practices at the National Reactor Testing Station (NRTS) near Idaho Falls, Idaho during the period October 15 to 22, 1968. The purpose of the examination was to review and evaluate the existing waste management operations to determine whether any additional water pollution control systems or procedures are necessary or desirable to carry out the national policy to improve water quality as set forth in Executive Order 11288, "Prevention, control, and abatement of water pollution by Federal activities."

The Federal Water Pollution Control Administration was represented by Dr. Milton Lammering and Richard Velten from the Technical Advisory and Investigations Office in Cincinnati, Ohio; and Harold Geren and Jack Seva of the Northwest Region, Portland, Oregon. The Idaho Department of Health was represented by Mr. Melvin D. Alsager.

An itinerary of the reconnaisance, including the names of those individuals with whom discussions were held, is presented as Appendix A to this report. All operating installations were visited except the Naval Reactors Facility. The representatives of the Atomic Energy Commission and the site contractors provided information on the treatment and disposal of liquid wastes and arranged for field visits to the various installations.

General Description

The National Reactor Testing Station was established in 1949. It consists of an 894 square miles reservation in Eastern Idaho between Idaho Falls and Arco that is used by the Atomic Energy Commission to build, test and operate various types of nuclear reactors. The NRTS also has facilities for the processing of spent reactor fuel elements and the calcining of highly radioactive liquid waste for long term storage.

More than 40 reactors have been constructed and operated at the NRTS during the last twenty years. Many of these have now fulfilled their purpose and have been dismantled, transferred or put in standby status. These reactors have been constructed and operated by private firms under contract with the AEC. Plant investment at the NRTS exceeds $450 million, with a replacement value exceeding $600 million.

The various reactor areas are widely dispersed over the Station. This dispersal provides protection in case of an accident, but also makes the use of a common water supply and waste disposal system impractical. The fresh water supply is obtained from wells located in each reactor facility area. In 1966, ground water with-drawal at the NRTS was about two billion gallons, or an average of about 5.4 million gallons per day.

This large water use also results in a large amount of waste water that must be discharged to the environment. Plant wastes which are contained in the waste water are of three general types: the radioactive waste, the chemical or industrial waste, and the sanitary waste. Waste disposal facilities are located at each facility area and are operated by the various AEC contractors.

Any liquid radioactive waste that is not suitable for release to the environment is transported to the calcining plant and converted to a solid for long term storage. The "low-level" radioactive waste is discharged to seepage pits, lagoons and directly to the underlying aquifer through disposal wells. The chemical wastes consist chiefly of brines from water-softening plants and corrosion inhibitors from cooling water systems. These wastes are also discharged to pits, lagoons and disposal wells. The sanitary waste consists of the effluent from

treatment plants and septic tanks. These wastes are discharged to drainfields, sumps, lagoons and disposal wells.

Zones of perched ground water have developed beneath some of the disposal ponds at the various facilities. These zones are generally perched on a sedimentary interbed in the basalt. The development of perched water zones beneath a waste discharge facility is very desirable from the standpoint of water pollution control, as it increases the travel time distance, and the amount of sorption the waste will receive prior to recharging the regional ground-water body.

The U.S. Geological Survey has been carrying on investigations for the AEC at the NRTS since its inception. They have supervised the drilling of many thousands of feet of test wells and have provided a very valuable service in testing, recording and evaluating geologic and hydrologic conditions at the NRTS. Their reports are the chief source of information on the effects of waste disposal on water quality at the NRTS.

NATIONAL POLICY RELATING TO POLLUTION CAUSED BY THE OPERATION OF FEDERAL FACILITIES

The purpose of the Federal Water Pollution Control Act is to enhance the quality and value of our water resources and to establish a national policy for the prevention, control, and abatement of water pollution. The policy for all Federal departments, agencies, and establishments of the Executive Branch of Government was spelled out in Executive Order 11288 "Prevention, control and abatement of water pollution by Federal activities." This policy states that Federal establishments shall provide leadership in a nationwide effort to improve water quality through prevention control and abatement of water pollution.

In order to enhance or improve water quality, it is the responsibility of each Federal activity to establish programs for the improvement of each waste treatment operation that contributes waste to the Nations water resources. These programs should provide for the best possible treatment methods available so as to demonstrate what can be done to enhance and improve water quality. In no event should the operation of Federal activites cause the further degradation of any of our water resources.

II. SUMMARY OF REPORT

1. This report reviews and evaluates the existing waste management operations at the NRTS to determine whether any additional pollution control systems or procedures are necessary or desirable to improve or protect water quality.
2. The report is based on an examination made during October 1968 and on reports and information provided by the Atomic Energy Commission and the U.S. Geological Survey.
3. The NRTS was established in 1949 for the purpose of testing nuclear reactors. More than 40 reactors have been constructed and operated since that time. The NRTS also contains a chemical processing plant for reclaiming fuel from used fuel elements and a calcining plant for converting highly radioactive liquid waste to a solid for long time storage.
4. The NRTS is located near the eastern end of the Snake River Plain in southeastern Idaho. This plain extends over 8000 square miles and was formed by a thick series of lava flows that partially filled the ancestral Snake River Valley.
5. The Snake River Plain is underlain by the Snake River Aquifer, one of the worlds most productive ground-water reservoirs. This aquifer discharges some 6,000 cubic feet per second in the Snake River Canyon at the western end of the Plain.

6. Recharge comes chiefly from rivers flowing out of the mountains bordering the Plain on the North. These streams sink into the porous lavas.
7. An estimated 2000 cfs of ground water moves beneath the Station in a generally southwesterly direction. Part of this is recharged on the Station and part is moving through from further up the Plain.
8. The travel time for ground water to move from the NRTS to the discharge area in the Snake River Canyon is not known but is estimated to exceed 100 years.
9. Ground water between the NRTS and the discharge area is being developed. Travel time from the NRTS to areas of potential development may be only a few years.
10. The depth to the water table generally increases in a southwesterly direction across the Station, and ranges from about 250 feet in the Test Area North to approximately 600 feet below land surface at the burial ground near the southwestern corner of the Station.
11. The various reactor areas are widely dispersed over the 894 square mile Station. Each facility has its own water supply and waste disposal system with the exception that all high level liquid radioactive waste is processed at the calcining plant and all solid radioactive waste is buried in the burial ground or stored underground in metallic containers.

12. Liquid wastes generated at the NRTS include radioactive wastes, chemical wastes and sanitary wastes. The low level radioactive wastes are discharged to seepage pits, lagoons and disposal wells. The chemical wastes are discharged to pits, lagoons and disposal wells and the sanitary wastes from sewage treatment plants are discharged to drainfields, sumps, lagoons and disposal wells.

13. The Geological Survey has been carrying on investigations at the NRTS since its inception. They have supervised the drilling of many thousands of feet of test wells and have prepared numerous reports describing the geology and hydrologic conditions at the Station. They have also performed a valuable service in monitoring the effects of waste disposal.

14. The National policy for water pollution control by Federal activities calls for the best possible treatment methods so as to demonstrate what can be done to enhance or improve water quality.

15. The Idaho Operations Office of the Atomic Energy Commission operates on the policy that water quality can be degraded to the upper limits of the Public Health Standards for drinking water at the point of first use below their operations.

16. The burial ground for solid radioactive waste disposal is located near the southwest corner of the Station. The waste is deposited in trenches excavated to the top of the lava surface and covered with silt and clay on a weekly schedule. There are no observation wells to monitor the effects of the burial ground on water quality.

17. Low level liquid radioactive waste is discharged to an excavated pit in the lava at the Experimental Breeder Reactor Area, into ponds and a shallow well at the Special Power Excursion Reactor Test Area, directly into the ground-water supply by a deep well at the Chemical Processing Plant Area, into ponds at the Test Reactor Area, and the Naval Reactors Facility, and into the ground water supply by drilled wells at the Test Area North.

18. Chemical waste is discharged to a pond and shallow well at the Experimental Breeder Reactor Area, into ponds and a shallow well at the Special Power Excursion Reactor Test at the Chemical Processing Plant Area, into a sump and directly into the ground-water supply by a deep well at the Test Reactor Area, into ponds at the Naval Reactors Facility and into ground water supply by wells at the Test Area North.

19. Sanitary wastes are discharged to a tile drain system at the Central Facilities Area, to a sewage treatment lagoon

at the Experimental Breeder Reactor Area, to seepage pits and drain fields at the Special Power Excursion Reactor Test Area, into seepage pits at the Chemical Processing Plant Area, into a seepage pit at the Test Reactor Area, to a lagoon at the Naval Reactors Facility and into the ground water supply by disposal wells at the Test Area North.

20. Chemical and radioactive wastes have degraded the ground water beneath the NRTS. The tritium is believed to be entirely contained beneath the Station in that it is decaying at a rate approximately equal to the rate of addition to the water supply. The ground-water supply beneath the NRTS has been degraded by hexavalent chromimum and chlorides and an increase in total dissolved solids.

21. There is no information available to show whether the waste disposal operations at the NRTS have yet migrated beyond the boundary of the Station.

22. Recommendations for additional water pollution control practices are made to improve and protect the water quality in the Snake Plain Aquifer. They include elimination of disposal wells that discharge waste directly into the ground water supply, the elimination of the use of seepage ponds for the disposal of chemical wastes, and the improvement of some sanitary waste treatment systems.

23. Recommendations for additional water pollution control practices are made to improve and protect the water quality in the Snake Plain Aquifer. They include elimination of disposal wells that discharge waste directly into the ground water supply, the elimination of the use of seepage ponds for the disposal of chemical wastes, and the improvement of some sanitary waste treatment systems.

24. It is also recommended that the Idaho Operations Office of the AEC adopt a broader definition of pollution so as to include any avoidable deterioration in water quality.

III. RECOMMENDATIONS FOR WATER POLLUTION CONTROL

The national policy for water pollution control calls for protection and enhancement of the nation's water quality. This policy applies directly to the valuable ground-water resources of the Snake Plain Aquifer underlying the National Reactor Testing Station. Present waste disposal practices have resulted in localized pollution of the Aquifer within the Station boundaries. The Federal Water Pollution Control Administration concludes that present disposal practices are a potential threat to the water resources of the State of Idaho.

With regard to radioactive wastes, FWPCA recommends that the Atomic Energy Commission initiate the following:

1) a positive comprehensive program for abandonment of the practice of burial or storage of radioactive wastes above the Snake Plain Aquifer including removal of such wastes presently buried or stored at the site; and

2) study of alternate treatment or disposal methods to result in elimination of tritium discharges to the Snake Plain Aquifer.

The Administration recognizes that these primary recommendations will require expenditure of both time and resources for implementation.

To provide some measure of protection to the Snake Plain Aquifer from radioactive wastes during this period, and to achieve acceptable handling of sanitary and chemical wastes the following measures are recommended:

1. Burial Ground

   a. A two to three-foot layer of silt and clay be placed in the bottom of the burial trench to separate the radioactive waste from the basalt surface.

   b. The radioactive waste material be covered with soil at the end of each day's disposal rather than on a weekly basis.

   c. An observation well or wells be constructed in proximity to the burial ground to monitor the effects of the burial ground on water quality.

2. Experimental Breeder Reactor II Area (EBR II)

   a. The use of a drilled well for the disposal of demineralizer waste be discontinued and the waste discharged to the chemical waste pond.

3. Special Power Excursion Reactor Test Area (SPERT)

   a. The demineralizer waste and the "blow down" waste at the new Power Burst Facility be discharged to a surface pond.

   b. The septic tank system at the Central Terminal be replaced with a lagoon or new treatment plant.

4. Chemical Processing Plant (CPP)

   a. The AEC expedite the installation of the ion exchange unit that will "polish" the condensate from the low-level evaporator.

   b. The AEC should follow the recommendations of the U.S. Geological Survey in their 1966 annual report by constructing the additional observation wells that are needed to better understand the behavior and fate of the wastes from the Chemical Processing Plant.

   c. To eliminate the threat of an accidental discharge of unacceptable waste directly into the Snake Plain Aquifer, the use of the deep well for the disposal of radioactive waste be discontinued.

d. The discharge of the chemical waste stream directly to the Snake Plain Aquifer by the deep disposal well be discontinued.

5. Test Reactor Area (TRA)

a. A review of the radioactive liquid waste program be initiated with emphasis placed on the development of treatment alternatives that would significantly reduce the release of the long-lived radionuclides, strontium-90 and cesium-137.

b. The capability to discharge the liquid radioactive wastes from the "hot" drains directly to the retention basin without a gross radioactivity analysis being performed be eliminated. All rad liquid waste from reactor experiments should be drained to catch tanks for analysis before discharge to the retention basin."

c. Equipment be installed to reduce the hexavelent chromium in the blowdown waste from the toxic hexavalent form to the less toxic trivalent form, or some less toxic corrosion inhibitor should be used in the system.

d. The use of the well for the disposal of the blowdown waste directly to the Snake Plain Aquifer be discontinued.

e. The discharge of the demineralizer waste stream to a seepage pond be discontinued.

6. Test Area North (TAN)

   a. The discharge of chemical wastes directly into the Snake Plain Aquifer through drilled disposal wells be discontinued.

   b. The discharge of septic tank and trickling filter effluent directly to the Snake Plain Aquifer through drilled disposal wells be discontinued.

7. Naval Reactors Facility (NRF)

   a. At least one observation well extending to the regional water table be located immediately down-gradient from the disposal lagoons.

8. General

   a. ID Chapter 0510-01 be modified to include the national policy for water pollution control and the Idaho Operations Office's definition of pollution (ID-0510-004) be broadened to include any deterioration in water quality.

   b. The ID Manual Appendix 0510 be amended so that the Radiation Protection Guide values (Part I) are clearly defined as to the concentration limits specified in Appendix B (TABLE II) of AEC Regulation 10CFR20.

   c. The characterization of liquid effluents be improved through expanded analytical analysis of monthly

composite samples to include quantitative identification of specific radionuclides and a modification of reporting procedures.

d. A quality control program be established by the Idaho Operations Office between the Analytical Chemistry Branch, AEC Health Services Laboratory, and the laboratories of the site contractors.

e. The Idaho Operations Office annual report on radioactive waste disposal operations should provide a comprehensive description of disposal activities during the year. In particular, emphasis should be placed on providing an insight to variations in radionuclide concentrations which occur as the result of batch-type operations as well as annual average concentrations.

f. The various chemical waste streams and the water supplies from the production wells be analyzed periodically.

g. Encourage the sewage plant operators to voluntarily become certified and expand the sanitary waste reporting to all sewage treatment installations.

IV. HYDROLOGIC SETTING

The Snake River Plain covers over 8,000 square miles in southeastern Idaho. It ranges up to 60 miles in width and extends for over 200 miles in a southwesterly direction from St. Anthony. It was formed by a series of lava flows that partially filled the ancestral Snake River valley. The plain is bordered on the north by several mountain ranges and intermontane valleys, and on the south by the Snake River. It is an arid region that generally receives less than 10 inches of precipitation per year and has an evaporation rate that exceeds three feet per year.

The plain is underlain by the Snake Plain Aquifer, one of the worlds most productive ground-water reservoirs. This aquifer which is formed by permeable zones in the lava, discharges some 6,000 cubic feet per second (cfs) in the Snake River Canyon at the western end of the plain. Recharge comes chiefly from the rivers flowing out of the northern mountains and sinking into the porous lavas. These rivers include the Big Wood, Lost River, Little Lost, Birch Creek, and several smaller streams.

The National Reactor Testing Station is located in the eastern end of the plain and contains the recharge areas created by the Lost, Little Lost, and Birch Creek Sinks. Some 2,000 cfs of ground water (1,300 million gallons per day) moves from beneath the station in a generally south to southwesterly

direction (Figure 1). Part of this ground water is recharged on the Station and part is moving through from further up the Plain.

The travel time from ground water moving from the NRTS to the discharge area in the Snake River Canyon is not known, but estimates made from ground water velocity tests indicate that the travel time will probably exceed 100 years.

Ground water between the NRTS and the discharge area is currently being developed by wells for domestic, irrigation and industrial supplies. Some ground water has already been developed immediately down gradient from the NRTS boundary. The amount of development in this area is expected to increase with the population growth of the area. The travel time for ground water to move into these areas from the NRTS would be only a few years.

The depth to the water table generally increases in a southwesterly direction across the Station, and ranges from about 250 feet in the Test Area North to approximately 600 feet below land surface at the burial ground in the southwest part of the Station. Numerous test wells have been constructed on the NRTS and detailed information on the geology and occurrence and movement of ground water is available in Geological Survey reports.

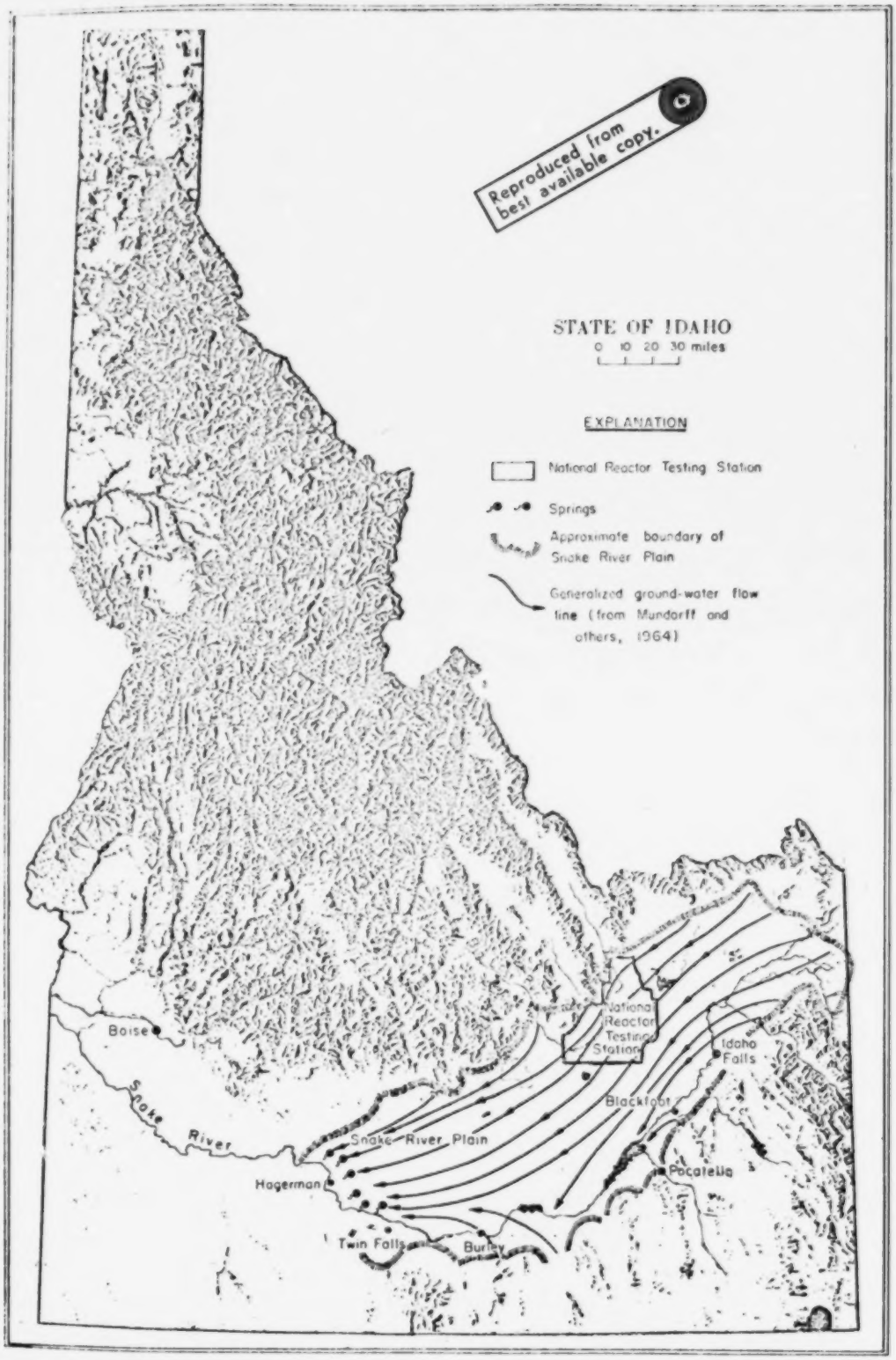


Fig. 1 Relief map of Idaho showing the location of the NRTS (National Reactor Testing Station) and inferred ground-water flow lines. - (From USGS TID-4500)

V. LIQUID WASTE MANAGEMENT

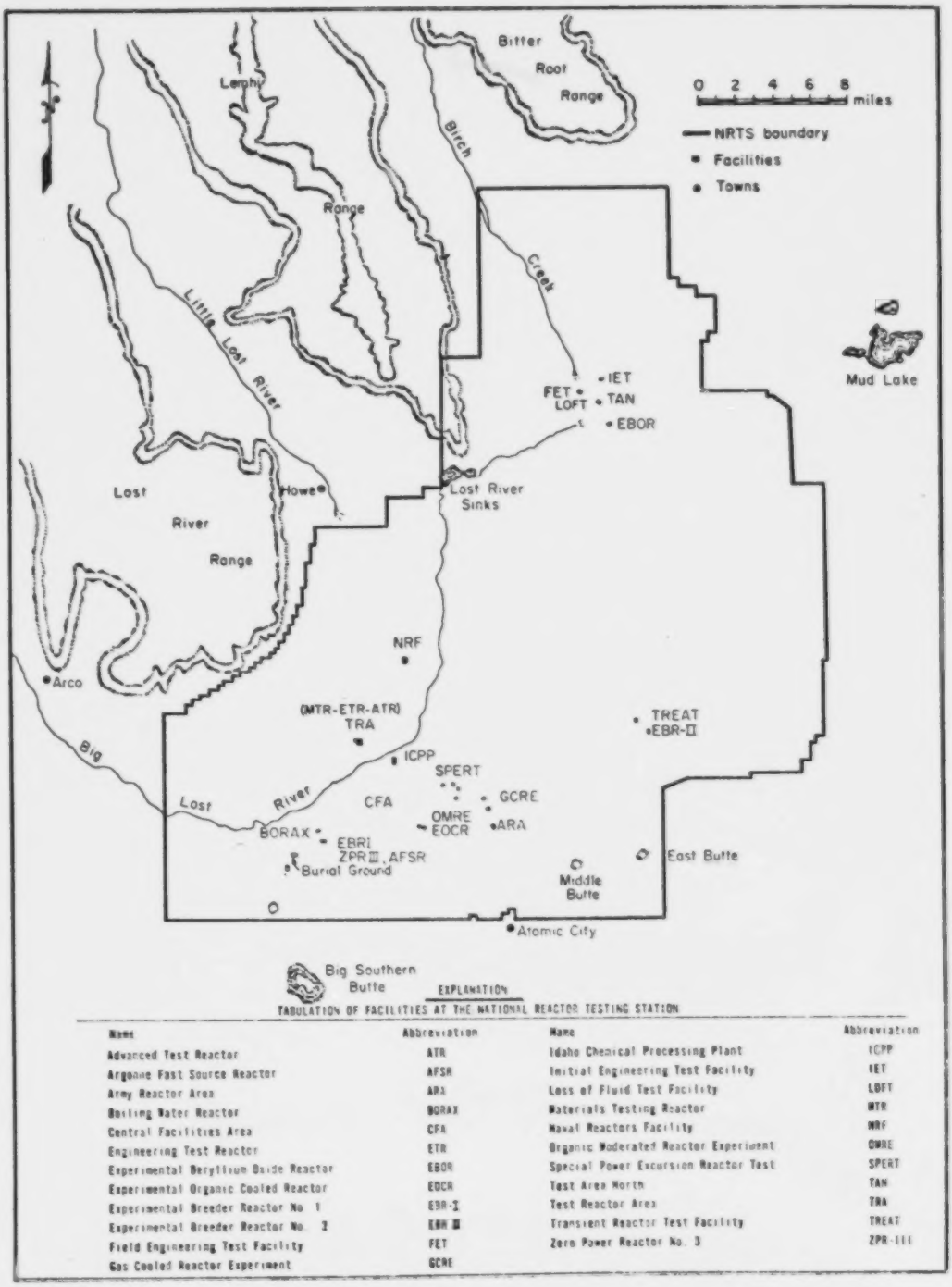
Each program function area at the NRTS is responsible for the treatment and disposal of the liquid wastes generated at the area facilities. Consequently, waste management procedures vary from facility to facility. The one exception to this pattern of decentralization is the management of high level radioactive wastes (on the order of 10^4 uc/ml of gross beta-gamma radioactivity). All high-level wastes are processed in the Waste Calcining Facility at the Chemical Processing Area.

The following sections describe the current waste treatment and disposal practices at each of the major NRTS facilities and recommendations for additional water pollution control practices to improve and protect the ground-water resources in the Snake Plain Aquifer. Figure 2 shows the location of the various facilities at the NRTS.

Burial Ground

Description and Operation

The burial ground for solid radioactive waste is located southwest of the Central Facilities in an area underlain with from five to twenty feet of silt and clay (loess?). This large variation in thickness is due to the irregular basalt surface that underlies this silt and clay deposit. The disposal trenches, which are about five to six feet in width, are excavated to the



TABULATION OF FACILITIES AT THE NATIONAL REACTOR TESTING STATION

Name	Abbreviation	Name	Abbreviation
Advanced Test Reactor	ATR	Idaho Chemical Processing Plant	ICPP
Argonne Fast Source Reactor	AFSR	Initial Engineering Test Facility	IET
Army Reactor Area	ARA	Loss of Fluid Test Facility	LOFT
Boiling Water Reactor	BORAX	Materials Testing Reactor	MTR
Central Facilities Area	CFA	Naval Reactors Facility	NRF
Engineering Test Reactor	ETR	Organic Moderated Reactor Experiment	OMRE
Experimental Beryllium Oxide Reactor	EBOR	Special Power Excursion Reactor Test	SPERT
Experimental Organic Cooled Reactor	EOCR	Test Area North	TAN
Experimental Breeder Reactor No. 1	EBR-I	Test Reactor Area	TRA
Experimental Breeder Reactor No. 2	EBR II	Transient Reactor Test Facility	TREAT
Field Engineering Test Facility	FET	Zero Power Reactor No. 3	ZPR-III
Gas Cooled Reactor Experiment	GCRE		

Fig. 2 Map of the NRTS showing the locations of facilities.

(From TID 4500)

basalt surface. The walls of the trenches stand vertical, with little evidence of caving. The solid waste is deposited in the trench with some waste lying directly on the basalt surface. The waste is covered with silt and clay on a weekly schedule.

The placement of solid radioactive waste directly on the basalt surface and the periodic covering of the waste creates a threat to ground-water quality. Rain, which does occasionally occur in the area (av. 8.2 inches per year), would fall directly on the radioactive waste and then flow into the underlying lavas. The amount of radioactivity that could be picked up by this water is not known, but there would be little or no sorption of the dissolved solids prior to flowing into the lavas.

The nearest observation well located down gradient from the burial ground is some three miles away and is believed effected by local recharge from flood control ponds and is not considered a satisfactory well to monitor the effects of the burial ground.

The Snake River Plain is not a desirable location for any burial ground for radioactive (or toxic) wastes because of the importance of the underlying ground-water supply. Even though the burial of radioactive waste may not be causing pollution at this time, climatic changes in the future could substantially alter this situation (Plutonium 239 that is being buried at the NRTS has a half-life of 24,000 years). Ideally a burial

ground for radioactive or toxic wastes should be located somewhere in the Great Basin, in a subbbasin that has little or no surface or subsurface outflow and is underlain by fine-grained sedimentary materials.

Recommendations

It is recommended that a layer of silt and clay of high sorbic capacity be placed between the waste and the underlying lava to permit additional sorption and that the waste be covered on a daily basis to prevent rainfall from falling directly on the waste.

In order to observe whether a pollution threat is being created by the operation of the burial ground, an observation well should be drilled at the burial ground.

Central Facilities Area (CFA)

Radioactive Wastes

Radioactive wastes from the laundry and analytical laboratories of the Health Services Laboratory are discharged to the sanitary waste system.

Sanitary Waste Treatment and Disposal System

The sanitary waste system consists of a primary settling tank, a digester, a trickling filter, a secondary settling basin, and an effluent chorination tank. The effluent is discharged to a subsurface tile drain system in the gravelly soil.

A summary of the waste treatment and disposal system is given in Table 1.

TABLE 1

SEWAGE TREATMENT AND DISPOSAL SYSTEM
AT THE CENTRAL FACILITIES AREA

People (No.)	Estimated Flow (gal/day)	Design Capacity (gal/day)	Equipment and Size
1,050	110,000 (including laundry)	28,800 min. 122,400 avg. 302,400 max.	Digester--35,600 gal. (4800 ft^3) Trickling Filter--0.27 acre-feet Primary Clarifier--27,000 gal. (3620 ft^3) Secondary Clarifier--27,000 gal. (3620 ft^3) Drying Beds--3060 ft^3) Subsoil Disposal--40,000 ft^2 area (Chlorinator)

Data Source: AEC Report IDO 12066 "Liquid Waste at the National Reactor Testing Station, Idaho" July 1968.

Plant operation records from January through September 1968 indicate that an overall BOD reduction exceeding 80 percent is attained. Effluent BOD, which ranged from 1.5 to 29 mg/l, was normally around 4.0 mg/l. The plant receives some low-level radioactive wastes which concentrate in the sludge and on the trickling filter. The dried sludge is disposed of at the burial ground. The effluent is samples daily to determine the net concentration of radioactive materials discharged to the drain field. The plant effluent is chlorinated just prior to disposal.

No operations problems were reported at the time of the visit.

Recommendations

The waste treatment plant at the Central Facilities Area appears to be operating satisfactorily and no recommendations are being made at this time except for voluntary certification of the operator.

Experimental Breeder Reactor II Area (EBR II)

The facilities in this area include the Experimental Breeder Reactor II (EBR II), the Transient Reactor Test Facility (TREAT), the Zero Power Plutonium Reactor (ZPPR), and the Fuel Cycle Facility.

Radioactive Wastes

The radioactive waste is collected in storage tanks, the acidity is neutralized, and the waste discharged to a covered disposal pit that has been excavated into the lava. An evaporator is maintained in a standby condition to handle waste that is not suitable for discharge to the disposal pit. If the waste is not suitable for discharge; it is concentrated by evaporation and handled as high level waste.

Chemical Wastes

The cooling tower "blowdown" is chemically treated to reduce the hexavalent chromium to the trivalent state. This waste stream is discharged to a large excavated pond where it is concentrated by natural evaporation. Plant operators at this facility reported that the pond is effectively sealed and that there is little or no

leakage to the ground. The waste stream going to this pond was very small at the time of our visit. The Idaho Operations Office reports that the lagoon receives approximately 85,000 gallons per week of cooling tower blowdown waste, and 350,000 gallons per week of cooling and miscellaneous waste (9). If the discharges are of this magnitude, some of the waste must be infiltrating into the ground as the pond is not of sufficient size for total disposal by evaporation.

The demineralizer waste is discharged to a shallow well drilled into the lavas. This subsurface disposal of chemical waste may be a minor threat to water quality, but every waste stream that reaches the water table contributes to ground-water degradation.

The open ditch that carries "blowdown" waste and other chemical wastes from the EBR II facility to the evaporation pond flows adjacent to Well No. 2. Any leakage from this ditch to the well would result in an above-average sulfate and chromium content in the well water.

Sanitary Waste Treatment and Disposal

The EBR II facility is served by a 200 x 200 foot lagoon, and the TREAT facility is served by two septic tanks. The lagoon receives wastes from about 500 people. Each septic tank serves six people.

The lagoon was in excellent condition at the time of inspection. According to the maintenance man, it does not normally overflow. It is drawn down by discharging to a seepage area before cold weather arrives and allowed to fill under ice-cover condition in the winter.

Recommendations

1. The use of drilled well for the disposal of the demineral-

izer waste should be discontinued, and the waste discharged to the chemical waste disposal pond. If a further study should indicate that there is substantial subsurface leakage from this pond, methods of reducing the leakage should be considered so as to prevent this pond from being a source of ground-water pollution.

Special Power Excursion Reactor Test Area (SPERT)

The reactors in this area are the SPERT II (standby), SPERT III (standby), SPERT IV (operating), and the Power Burst Facility (PBF) (under construction).

Radioactive Waste

The waste at SPERT IV is filtered (microfilter), collected in storage tanks and disposed of to a surface seepage pond. At the PBF the radioactive waste will be collected in a storage tank and subsequently discharged to a permeable zone in the lavas at a depth of 74 to 104 feet.

Chemical Wastes

Demineralizer waste at SPERT IV is discharged to the radioactive waste seepage pond. At the PBF, the cooling tower "blowdown" will be chemically treated to reduce the hexavalent chromium to the trivalent state. This waste stream and the demineralizer waste will be discharged to a shallow well.

Sanitary Waste Treatment and Disposal

The sanitary waste treatment and disposal systems at the SPERT

area are described on Table 2. No problems with the operation of these treatment systems was reported, but the septic tank at the Control Terminal and Pit Building is operated at about three times the desing capacity.

Recommendations

1. Eliminate the proposed disposal well for the demineralizer waste at the PBF and discharge the waste to the desert through the "blowdown" waste disposal ditch.
2. In view of the relatively high number (75) of employees at the Control Terminal area and the fact that the septic tank serving the area is only one-third the recommended size, the construction of a lagoon similar to that at EBR II, or a treatment plant should be considered to replace the tank.

Chemical Processing Plant Area (CPP)

The major facilities in this area are the Idaho Chemical Processing Plant, the Waste Calcining Facility, and the Fuel Element Storage Facility (water-filled basin).

Radioactive Waste

Low-level (10^{-2} uc/ml) and intermediate level (10^{-2} to 10^{4} uc/ml) radioactive wastes generated at the CPP is processed by an evaporator. The evaporator condensate is collected in storage tanks and discharged after analysis directly to the Snake Plain Aquifer through a 595-foot well. The radwaste is diluted with plant cooling water just prior to disposal.

TABLE 2

SEWAGE TREATMENT AND DISPOSAL SYSTEMS
AT THE SPERT AREA

People (No.)	Estimated Flow (gal/day)	Design Capacity (gal/day)	Sewage Treatment	Equipment & Size
			Control Terminal and Pit Building	
75	2500	800	Septic tanks, seepage pit	Two septic tanks--600 gal.ea. Seepage pit--3380 gal (452 ft^3)
			Temporary Engineering Office Building	
10	300	333	Septic tank, seepage pit	Septic tank--500 gal Seepage pit--1030 gal (138 ft^3)
			Spert II	
		415	Septic tank, seepage pit	Septic tank--625 gal Seepage pit-1180 gal (157 ft^3)
			Spert III	
4	100	415	Septic tank, seepage pit	Septic tank--625 gal Seepage pit--1180 gal (157 ft^3)
			Spert IV	
		665	Septic tank, seepage pit	Septic tank--1,000 gal seepage pit--3000 gal (401 ft^3)
			Temporary Construction Office	
50	1500	1000	Septic tank, seepage pit	Septic tank--1000 gal.
			PER-PBF-620 (Proposed)	
16	500	800	Septic tank	Septic tank--800 gal. Disposal to drainfield

Data Source: AEC Report IDO-12066 "Liquid Waste at the National Reactor Testing Station, Idaho", July 1968.

One of the reasons for utilizing deep-well disposal was reported to be the fear that a perched water zone could develop from near-surface disposal that would jeopardize the subsurface storage tanks used for the high level liquid radioactive waste and solids from the calciner.

There is no liquid waste stream from the Waste Calcining Plant. Water from the storage basin at the Fuel Element Storage Facility is continuously circulated through two clinoptilalite filters in series. There is no direct discharge of water to the ground at this facility.

The disposal of tritium, the radionuclide accounting for approximately 96 percent of the gross beta-gamma activity discharged annually at the CPP, has received considerable attention by the AEC and the Geological Survey as to its impact on the subsequent uses of the Snake Plain Aquifer. For the period of 1961 through 1966, the tritium plume remained well within the site boundaries of the NRTS--the farthest southward progression of the estimated "zero" contour lying in the vicinity of Highway 20. It is probable that tritium in the regional ground water has reached a quasi-steady-state condition with there being little likelihood for more extensive spreading of the plume than previously observed unless tritium releases increase.

During the discussions with representatives of Idaho Nuclear Corporation, the AEC contractor that operates the Chemical Processing Plant, the reconnaissance team was informed that a proposal calling for the passage of the condensate from the low-level evaporator

through an ion exchange unit had been submitted to the Atomic Energy Commission (its installation has been approved by the AEC subsequent to our visit). If the aniticipated decontamination factor of 100 is obtained, this additional treatment should lower the effluent strontium-90 concentration from $1 - 3 \times 10^3$ pc/1 to 100 pc/1, and the total amount of radioactivity discharged, exluding tritium, to considerably less than one curie per year. This proposal constitutes a positive attempt aimed at minimizing the release of radioactive materials.

The discharge of radioactive waste directly to the Snake Plain Aquifer has not created a problem in the use of the ground-water supply. The practice of discharging radioactive waste directly into the water supply, however, does create a potential threat to the valuable resource. The threat comes from continued use of the aquifer for the disposal of radioactive wastes and from the possibility of an unintentional or accidental release of unacceptable waste to the disposal well. Such a release occurred on December 9, 1958, when waste from an unknown source in the CPP resulted in the discharge of waste to the disposal well that had a concentration of strontium-90 that was 225 times the maximum permissible concentrations (7).

Chemical Wastes

Chemical wastes at the CPP comes chiefly from the water treatment plant. This waste, which is principally sodium chloride and

sodium sulfate, is diluted with the plant cooling water and the radioactive waste and is discharged to the deep disposal well. The maximum concentration of chloride in the combined waste stream going to the well was reported not to exceed 375 mg/l (9), but averages well over 200 mg/l. This discharge has caused a marked increase in the chloride content of the ground water supply. The chloride content at the CPP Well No. 2 has increased from 10 to 42 mg/l from 1951 to 1968, and at the Central Facilities Well No. 2, from 23 to 58 mg/l from 1956 to 1968. The desirable limit for chloride in a public water supply recommended by the National Technical Advisory Committee on Public Water Supplies (10) is "less than 25 mg/l."

Sanitary Waste Treatment and Disposal

The sanitary waste treatment and disposal systems in the Chemical Processing Plant Area are described in Table 3. The treatment plant was operating satisfactorily. Records on plant operations from January through September 1968 indicate that an overall BOD reduction of 80 percent is attained. Effluent BOD, which ranged from 4.5 to 25 mg/l during the period, was normally about 11 mg/l. No operational problems were reported in either the treatment plant or the septic tanks.

Recommendations

1. The Atomic Energy Commission should expedite the installation of the ion exchange unit which will "polish" the condensate from the low-level waste evaporator.

TABLE 3

SEWAGE TREATMENT AND DISPOSAL SYSTEMS
AT THE CHEMICAL PROCESSING PLANT AREA

People (No.)	Estimated Flow (gal/day)	Design Capacity (gal/day)	Sewage Treatment	Equipment and Size
310	26,000	59,000 (c)	Imhoff Process, Digester Chlorination basin, Trickling filter, Drying Bed, and Seepage Area (closed underground)	Imhoff Tank--3400 gal (457 ft^3) Trickling Filter--0.0678 Acre Feet Final Settling--2580 gal. tank Chlorination Tank--450 gal (60 ft^3) Modified Tank--570 gal (77 ft^3) Seepage Area--5150 ft^2) Sludge Drying Beds--730 ft^3
< 20		632 (a)	Calciner Septic Tanks plus Deep Seepage Cesspool, DPP-633	Two Septic Tanks--Each Tank--800 gal. Cesspool--8' x 8' x 16' deep
<10		575 (b)	Fuel Storage Building Septic Tank with Open Bottom Dry Well, CPP-603	Septic Tank--860 gal. Dry Well--5' Diameter
<10		360 (b)	Limited Area Control House (CPP-609) Septic Tank, Seepage Cesspool	Septic Tank--540 gal. Seepage Cesspool--6'
		360 (b)	Waste Disposal Building, Septic Tank, Seepage Cesspool	Septic Tank--540 gal. Seepage Cesspool

(a) Design V = 1125 + 0.75 (gal sewage).
(b) Sewage tanks designed to hold 1-1/2 days flow.
(c) Imhoff retention time of 1.38 hour.

Data Source: AEC Report IDO 12066, "Liquid Waste at the National Reactor Testing Station, Idaho", July 1968.

2. As suggested by the U.S. Geological Survey in their most recent annual report (2, page 73), the additional observation wells needed to resolve any unanswered questions regarding the behavior and fate of wastes from the Chemical Processing Plant should be drilled. The final complement of observation wells should be capable of accurately defining the areal extent and depth(s) of the tritium plume.
3. To eliminate the possibility of an accidental discharge of unacceptable radioactive waste directly to the Snake Plain Aquifer, the use of the deep well for the disposal of radioactive waste to the Snake Plain Aquifer should be discontinued.
4. The discharge of the chemical waste directly to the Snake Plain Aquifer through the deep disposal well should be discontinued.

Test Reactor Area (TRA)

The Test Reactor Area (TRA) is the world's largest and most advance nuclear test complex containing the Meterials Testing Reactor (MRT), the Engineering Test Reactor (ETR), and the Advanced Test Reactor (ATR).

Radioactive Waste

The radioactive wastes at the TRA are classified as "hot" or "warm" with separate collection systems maintained for each type. Hot wastes originate from the reactors and reactor experiments,

whereas the warm wastes originate from floor drains and reactor sumps. These radioactive wastes are transferred from collection tanks to a concrete retention basin. The waste from the basin is discharged to ponds excavated in the gravelly alluvium that overlies the lava in this area. No treatment is provided with the exception that a waste batch can be trucked to the Waste Calcining Facility if such action is deemed necessary.

Leakage from the disposal ponds has created an extensive perched ground-water zone beneath the area. Recharge to the regional water table comes from downward percolation of the perched water. Sorption in the soil removes most of the radioactive nuclides in the waste except for tritium. The removal of radioactive nuclides and other ions is "temporary" in that the removal will occur only until equilibrium is reached.

Chemical Wastes

Cooling tower "blowdown" from the large cooling towers at the TRA is discharged directly to the Snake Plain Aquifer through a 1200-foot disposal well. This waste is the principal source of the hexavalent chromium that is introduced into the ground water at the NRTS. It now averages about 175 gpm and will be increased by about 300 gpm when the new test reactor is put into operation. The hexavelent chromium in this waste was reported to range from about 4 to 5 mg/l. This waste stream constitutes one of the most serous threats to ground-water quality at the NRTS. At places around the TRA, the hexavalent-chromium in the ground water

already exceeds Public Health Service standards for drinking water (0.05 mg/l).

The demineralizer waste is discharged to a pond excavated in the gravelly alluvium. The waste, which is derived from sulphuric acid, sodium hydroxide, and dosium chloride, now averages about 3,500,000 gallons per month. Total dissolved solids in the ground water have increased from about 250 mg/l prior to disposal, to 850 mg/l after disposal was started. This waste stream is also a serious source of ground-water pollution.

Sanitary Waste Treatment and Disposal

The sanitary waste treatment and disposal systems in the Test Reactor Area are described in Table 4.

Plant operation records from January through September 1968 indicate that BOD reduction in excess of 80 percent is attained. Effluent BOD, which ranged from 4.5 to 37 mg/l during the period, was normally about 14 mg/l. The treatment plant effluent is discharged to two seepage ponds. The system was operating satisfactorily when viewed and no problems were reported. A laboratory building in the area is served by a 600-gallon septic tank.

Recommendations

In comparison to other facilities, the greatest on-site release of radioactivity from liquid waste disposal occurs at the Test Reactor Area. Yet the TRA has the distinction of being the only area without treatment capabilities for liquid radioactive wastes; other than being able to truck batches of "hot" waste to the chemi-

TABLE 4

SEWAGE TREATMENT AND DISPOSAL SYSTEMS
AT THE TEST REACTOR AREA

People (No.)	Estimated Flow (gal/day)	Design Capacity (gal/day)	Equipment and Size
860	27,000	59,000 (a)	Imhoff Tank--3400 gal (457 ft^3)
			Trickling Filter--0.0678 Acre Feet
			Final Settling--2480 gal. tank (331.5 ft^3)
			Chlorination Tank--450 gal. (60 ft^3)
			Modified Tank--570 gal (77 ft^3)
			Seepage Area--7750 ft^2
			Sludge Drying Beds--730 ft^3

(a) Imhoff retention time of 1.38 hours.

Data Source: AEC Report IDO 12066, "Liquid Waste at the National Reactor Testing Station, Idaho", July 1968.

cal plant. Similarly, this is the only area in which the discharge of chromate-bearing cooling water blowdown is still permitted.

The Naval Reactors Facility has replaced chromate with a polyphosphate and at the Experimental Breeder Reactor II, the hexavalent chromimum is reduced to the trivalent form.

1. A review of the radioactive liquid waste program at the TRA should be initiated with emphasis placed on the development of treatment alternatives that would significantly reduce the releases of the long-lived radionuclides, strontium-90 and cesium-137.
2. The capability to discharge radwastes from the "hot" drains directly to the retention basin without a gross radioactivity analysis being performed should be eliminated. All wastes from reactor experiments should be initially drained to catch tanks for analysis.
3. Equipment should be installed to reduce the hexavalent chromium in the blowdown waste from the toxic hexavalent form to the less toxic trivalent form, or some less toxic corrosion inhibitor should be used in the system.
4. The use of the well for the disposal of the blowdown waste directly to the Snake Plain Aquifer should be discontinued.
5. The discharge of the demineralizer waste stream to a seepage pond should be discontinued. Possibly waste reactor heat could be utilized in an evaporation pond to increase the evaporation rate of this waste stream.

Test Area North (TAN)

The bulk of activity at TAN occurs in the centralized Technical Services Facility. Other testing facilities are the Initial Engineering Test Facility (IET), The Low Power Test Facility (LPTF), the Field Engineering Test Facility (FETF) at which the reactor experiment, Loss-of-Fluid Test (LOFT) is scheduled for testing. Each facility has independent systems for the treatment and disposal of liquid wastes.

Radioactive Wastes

Radioactive waste at the Technical Services Facility is collected, evaporated, and then discharged directly to the Snake Plain Aquifer through a drilled disposal well. No radioactive wastes are generated at the Initial Engineering Test Facility and the Low Power Test Facility. Operational procedures for the handling and disposal of liquid radioactive wastes at the LOFT site have not been established. However, there will be at least one 100,000 gallon holding tank provided for this purpose.

Chemical Wastes

Chemical wastes which consist chiefly of demineralizer wastes are discharged directly to the Snake Plain Aquifer through drilled disposal wells. A 1968 chemical analysis of ground water from Well No. 2 by the U.S. Geological Survey in the TAN area shows the ground water as having a phenol content five times the maximum permissible limit for public water supplies. The location of the waste

stream or streams discharging phenols to the ground is not known.

Sanitary Waste Treatment and Disposal

Table 5 describes the sanitary waste treatment and disposal systems at the TAN area. The disposal wells discharge the trickling filter effluent and the effluent from the septic tanks directly into the Snake Plain Aquifer. The reason given for the use of drilled wells for sewage disposal is that the relatively tight soils in the area makes the use of drain fields troublesome.

Recommendations

1. The discharge of chemical wastes directly into the Snake Plain Aquifer through drilled disposal wells should be discontinued. The relatively tight soils in this area should facilitate the construction and operation of evaporation ponds for these wastes.
2. The discharge of septic tank and trickling filter effluent directly to the Snake Plain Aquifer through drilled disposal wells should be discontinued. Lagoons, similar to the lagoon at the EBR II should prove to be an effective substitute to well disposal.

Naval Reactors Facility (NRF)

The major installations comprising the NRF are the Submarine Prototype (S1W), the Large Ship Reactor (A1W), the Expended Core Facility (ECF), and the Natural Circulation Reactor (S5G). The Expended Core Facility, operated for the Commission and the U.S.

TABLE 5

SEWAGE TREATMENT AND DISPOSAL SYSTEMS
AT THE TEST AREA NORTH

People (No.)	Estimated Flow (gal/day)	Design Capacity (gal/day)	Sewage Treatment	Equipment and Size
			TAN/TSF Administration Area	
410	16,000 (b)	59,000 (a)	Imhoff Process, Chlorination Basin, Trickling Filter, Sludge Drying Beds, Disposal Well	Imhoff Tank--3400 gal (457 ft^3) Chlorinator--560 gal (75 ft^3) Trickling filter--0.067 Acre Feet Sludge Bed--835 ft^3
			IET AREA	
10	300	2,000 (b) designed for 50 people	Septic Tank Chlorination Building, Filter Bed, Disposal Well	Septic Tank--2800 gal (c) Filter Bed--265 ft^3 (Sand)
			STEP AREA	
30	1,000	4,000 (b) designed for 100 people	Septic Tank Chlorination Building, Disposal Well	Septic Tank--4200 gal (c)
			LPT & FBOR AREAS	
35	1,000	6,000 (b)	Septic Tank Chlorination Building, Filter Bed, Disposal Well	Septic Tank--5600 gal (c) Filter Bed 735 ft^3

(a) Imhoff retention time of 1.38 hour.

(b) 40 gallons per day per person for design capacity (TRA area figures).

(c) Design V = 1125 + 0.75 (gal. sewage).

Data Source: AEC Report, IDO 12066, "Liquid Waste at the NRTS, Idaho", July 1968

Navy by Westinghouse Electric Corporation, handles the dismantling and analysis of expended cores from nuclear ships preparatory to fuel reprocessing. Consequently, this facility has the greatest potential for the generation of liquid radioactive wastes. As the Naval Reactors Facility was not visited during our examination, the following information was provided by the Idaho Operations Office.

Radioactive Wastes

Liquid radioactive wastes generated at each of the three reactor plants are normally collected, analyzed for radioactivity and discharged to either an open or covered leaching pit. In the event of abnormally high radioactivity levels, these wastes can be routed through a bank of demineralizers. Liquid radioactive wastes from the ECF are segregated and processed by evaporation or discharged to retention basins depending on the gross radioactivity level. After sampling and analysis the ECF wastes are pumped from the retention basins to the leaching pits.

Preliminary work directed toward reducing the total activity discharged to the environment was started in 1966. The changes and/or modifications that are being made in the liquid radioactive wastes management practices include:

1. Treatment of the ECF pit skim water to remove the radioactivity with return of the treated water for reuse. It is envisioned that this change will result in a major reduction in the volume and radioactivity of the liquid waste discharged at the NRF.

2. Segregation of liquid wastes to eliminate processing large volumes of waste. This will also prevent the radioactive contamination of non-radioactive liquid wastes.
3. Installation of filtration equipment to remove suspended radioactive materials prior to discharge to the leaching beds.

Actual work on modifying the systems at NRF in accordance with the above is scheduled to commence early in calendar year 1970.

Although radioactivity analyses are performed on the wastes discharged to the leaching beds, there are no observation wells to monitor the regional ground water in the area down-gradient from the disposal beds.

Chemical Wastes

Cooling tower blowdown, spent demineralizer regenerates, and other miscellaneous wastes are discharged via culverts to a dredged drainage ditch located west and north of NRF. This ditch serves as a seepage system. The excess flow is discharged to a depression on the desert. A polyphosphate compound has replaced chromates as the corrosion inhibitor in the cooling water system.

Sanitary Waste Treatment and Disposal

The 1968 compilation of liquid waste at the NRTS (9) reports that the sanitary waste is discharged to a lagoon that has been constructed with an impervious bottom. The overflow from this lagoon goes to a second lagoon for further aerobic digestion. The overflow

from the second lagoon flows to a drain ditch and is discharged to the desert.

Recommendations

1. At least one observation well extending to the regional water table should be located immediately down-gradient from the disposal lagoons. Periodic analysis of water from such a well would provide information on the pollution threat from the NRF operation.

General Operating Procedures

Analysis of Radwaste Effluents

Compliance with the concentration limits for the discharge of liquid wastes is generally determined by obtaining a representative sample of the batch scheduled for release and performing gross beta and gamma analyses. Supplementing this procedure, daily proportional samples of the effluents containing radionuclides are collected at the Test Reactor Area, and the Chemical Processing Area. Gross beta and gamma analyses are performed on these samples. Monthly proportional composite samples are also prepared from the batch samples or daily proportional samples. These composite samples are analyzed for gross alpha radioactivity, gross beta-gamma radioactivity, tritium, and the major gamma-emitting radionuclides (quantitatively).

Recommendations

1. As part of the indicated revision to be made in ID Manual Appendix 0510, it is recommended that Radiation Protection

Guide Values (Part I) be clearly defined as referring to the concentration limits specified in Appendix B (Table II) of AEC Regulation 10CFR20.

2. Analytical analysis of a monthly composite waste samples should include the following:

   a. Continued determination for gross alpha and beta activity;

   b. Quantitative identification of specific radionuclides including tritium, manganese-54, cobalt-58 and 60, zinc-65, strontium-89 and 90, ruthenium-103 and 106, iodine-131, cesium-137, cerium-141 and 144, promethium-147, and those radionuclides responsible for the alpha activity. It is recognized that each of these radionuclides will not be major constituents in the liquid wastes from each installation. The decision to not conduct the analysis for a given radionuclide should be based on analytical data which demonstrates its absence or relative non-importance; frequent analytical checks should be performed to ensure the continued validity of such a decision. In much the same manner that specific radionuclides may be deleted from the above list to meet the monitoring requirements at a specific installation, it may be necessary in some cases to add other radionuclides not listed (for example, iodine-129 and/or radium-228).

c. Specific conductivity, pH, and determination of total dissolved solids;

d. Quantitative identification of the major inorganic Constituents (cations and anions).

3. Relative percentage(s), as required on the AEC Radioactive Liquid Waste Report (form ID-111) is based on the total activity computed by summing the activity results for the identified radionuclides. If it is unsure that all the radionuclides have been identified, the total so calculated should be checked against a similar total computed from gross counting procedures. The significance of tritium should also be reflected in the computation of relative percentages.

4. A quality control program should be established between the Analytical Chemistry Branch, AEC Health Services Laboratory, and the laboratories of the site contractors. Such a program would appear to be essential to ensuring the procurement of reliable data on liquid radioactive waste releases and compliance by the contractors with established effluent concentration limits.

5. The annual report on radioactive waste disposal operations should present a comprehensive description of disposal activities during the subject year. Sufficient data and narrative should be presented so as to provide the informed reader with an insight to variations in radionuclide concentrations occurring as the result of batch-type operations as well as annual average concentrations. Correspondingly, the annual report should include the following information for each area on a monthly basis.

    a. Number of days of radioactive waste discharge;
    b. Radioactive waste volume prior to dilution and dilution factor if the radwaste is combined with industrial wastes and/or sanitary sewage;
    c. Total volume of combined waste (if applicable);
    d. Analytical results for monthly composite sample.

6. During our survey at the NRTS it was found that there is no chemical monitoring of the waste and no monitoring of the water supplies except for radioactivity, bacteria and

chromium. It appears desirable in light of the large amount of chemical waste going to the ground that the various chemical waste stream and water supplies be periodically analyzed for total dissolved solids, conductivity, chlorides and pH. Any material change in waste characteristics or in water quality could probably be detected by these tests and could be followed by more complete analyses if a change occurred.

7. Encourage the sewage treatment plant operators to voluntarily become certified and expand the sanitary waste reporting to all sewage treatment installations.

VI. ATOMIC ENERGY COMMISSION POLLUTION CONTROL POLICY AND OBJECTIVES AT THE NATIONAL REACTOR TESTING STATION

The policy of the Idaho Operations Office of the Atomic Energy Commission relating to the management and control of waste materials at NRTS is presented in ID Chapter 0510 a supplement to AECM Chapter 0510, "Prevention, Control, and Abatement of Air and Water Pollution by Federal Activities". Specific policy requirements are to (ID-0510-02):

1. Minimize waste materials at the source by diligent and efficient operations;
2. Disperse waste materials to the environment only when this can be done without adverse effects and within prescribed limits;
3. Stabilize and maintain control of waste material.

The Idaho Operations Office defines pollution as "the presence in the environment of substances in quantities which are injurious to human, plant, or animal life or to property" (ID-0510-004), and operates under the policy that chemical waste can be discharged to the regional ground-water supply to the extent that the receiving water quality, at the point of first use, does not exceed the recommended upper limit of the drinking water standards of the Public Health Service. Under this policy a severe deterioration in ground-water quality beneath the NRTS and a deterioration in water quality outside the NRTS could occur without being interpreted as water pollution. Hexavalent chromium in the ground water near the

Test Reactor Area (TRA) already exceeds the Public Health Service standards for drinking water. As this ground water is not yet being developed, there is no injury to human, plant, or animal life or to property at this time, and therefore is not interpreted as water pollution by the Idaho Operations Office. A 1968 chemical analysis from the TAN shows the phenol content of water from the supply well in that area to exceed the permissible limit for public water supplies. Brine disposal at the NRTS has increased the chloride concentration in the water supplies at the Central Facility Area (CFA) and Chemical Processing Plant (CPP) above the desirable limit for public water supplies and recommended by the National Technical Advisory Subcommittee for Public Water Supplies (10).

Guidelines or concentration limits for the disposal of liquid radioactive wastes are considered in detail in ID Manual Appendix 0510 (Part I, Section A). These basic guides set the limits of radionuclide concentrations in liquid waste discharged to the ground or to ground water at levels such that the subsequent concentrations in the regional ground water at any point of use will not result in a dose to individuals in excess of 1/10 of the appropriate Radiation Protection Guide (RPG) values. Correspondingly, specific concentration limits have been established for the acceptable disposal of liquid waste. Factored into the development of these effluent limits were the probable reductions in concentration which will occur as the result of radioactive decay, sorption, dispersion, and initial

dilution.

Discussion with Dr. C. Pelletier, Chief, Environmental Branch, indicated that the term, RPG values, refers to the concentration limits specified in Appendix B (Table II) of Atomic Energy Commission (AEC) Regulation 10CFR20. It also seems reasonable to assume that the reference to individuals in the basic guide applies equally well to the average dose of an exposed population group. The distinction between individuals in the general population and the general population "per se" is significant since it is common practice to set the individual dose three time higher than the average dose for the population group. Nevertheless, the dose reduction factor of 1/10 is conservative when compared to the recommended factor of 1/3.

Regualtions of the State of Idaho which are directly applicable to the manner in which liquid wastes are disposed of at NRTS are presented as paragraphs 5.C and 6.H of "Rules and Regulations for Standards of Water Quality and for Waste Water Treatment for Waters of the State of Idaho" (Appendix B)

> "5.C Radioactive materials or radioactivity in water which exceeds (1) 1/30th of the RCG values given in Column 2, Table II, Appendix A, Part C, Rules and Regulations for the Control of Radiation in the State of Idaho (2) exceeds concentration limits of the Idaho Drinking Water Standards for waters used for, or likely to be used for, domestic supplies; (3) results in accumulations of radioactivity in edible plants and animals that present a hazard to consumers, and/or (4) is harmful to aquatic life."

> "8.H Waste discharges to underground waters shall receive, prior to discharge of such wastes, such treatment as is necessary to render them equal in quality to existing underground waters or such treatment as is necessary to bring such discharge into conformance with the

Idaho Drinking Water Standards. The provisions of Paragraph 8.H will not be considered as strictly applicable to the existing sink wells used exclusively for irrigation waste-water disposal where such disposal does not adversely affect domestic water sources. However, it should be recognized that the long-term preservation of Idaho's vast underground water resources is of great importance and that every reasonable effort should be made to reduce pollution from this source and that a long-term research and development program should be established that will lead to the total elimination of disposal wells that directly affect underground aquifers that are not subject to adequate filtration and percolation to eliminate significant pollution.

Further, this paragraph shall not be construed to preclude the use of deep disposal wells which may be constructed to discharge into underground water strata whose quality is such that it is not likely to be used for other beneficial purposes, provided necessary precautions are taken to prevent contamination of usable aquifers.

The basic and specific guides for the disposal of liquid wastes at NRTS are not in agreement with the above Idaho regulations. The conflict between the AEC's basic guide and paragraph 5.C is not great. However, the difference between the specific guides and paragraph 8.H is appreciable.

The specific objectives of the pollution prevention, control and abatement program at the NRTS are as follows (ID-0510-02):

1. Protect the health and safety of on-site personnel and the general public.
2. Maintain an inoffensive environment at the NRTS.
3. Protect the economic interest of the Nation, State and local communities.

Recommendations

The objectives of the pollution prevention, control and abatement program of the Idaho Operations Office (ID-0510-02) should be modified to include the Federal objective of the national policy for water pollution control as set forth in Executive Order 11288:

> "To provide leadership in the nationwide effort to improve water quality through prevention, control, and abatement of water pollution."

and the Idaho Operations Office's definition of pollution should be broadened to include any avoidable deterioration in water quality similar to that adopted by the State of Idaho (Appendix B)

"Pollution" means such contamination or other alteration of the physical chemical or biological properties of the public waters of the State, including change in temperature, taste, color, turbidity or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into the waters of the State which either by itself or in connection with any other substance present, will or can reasonably be expected to create a public nuisance or render such waters harmful, detrimental or injurious to public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate uses or to livestock, wildlife, fish or other aquatic life or the habitat thereof."

With such a broader definition of pollution and with a new program objective for water pollution control, the Idaho Operations Office could provide Federal leadership in improving and protecting the water quality in the Snake Plain Aquifer.

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APPENDIX A

ITINERARY FOR OCTOBER 1968
RECONNAISSANCE OF THE NATIONAL REACTOR TESTING STATION

APPENDIX A

Itinerary for October 1968

Reconnaissance of the National Reactor Testing Station

October 15

Morning:

1. Brief meeting at the Idaho Operations Office of the Atomic Energy Commission with Mr. William L. Ginkel, Manager, and the following members of his staff:

   Mr. Ralph V. Batie, Chief, Hazards Control Branch;
   Mr. John T. Collins, Industrial Hygiene Engineer;
   Dr. George L. Voelz, Director, Health Services Laboratory.

2. Meeting in the office of Dr. Voelz (Central Facilities Area) for the purpose of setting up a suitable itinerary. The following members of the Health Services Laboratory staff were in attendance:

   Dr. Charles A. Pelletier, Chief, Environmental Branch;
   Mr. Bruce L. Schmalz, Radiation Soil Scientist.

   Mr. J. Collins and Mr. Jack T. Barraclough, U. S. Geological Survey, were also in attendance.

Afternoon:

1. Visit to the NRTS burial ground area;

2. Brief discussion of "Guides for Radioactive Waste Disposal" Part I of ID Manual Appendix 0510, "Prevention, Control and Abatement of Air and Water Pollution" with Dr. Pelletier and Mr. Schmalz;

3. Tour of Health Services Laboratory analytical laboratories and counting facilities (Mr. Claude Sill, Chief, Analytical Chemistry Branch);

4. Brief meeting with Mr. J. Weaver McCaslin, Manager, Health and Safety Branch, Idaho Nuclear Corporation, and members

of his staff for the purpose of establishing a schedule for the Test Reactor Area, Test Area North, Chemical Processing Plant, and sewage treatment facility for the Central Facilities Area.

October 16

Morning:

Visit to the Experimental Breeder Reactor No. 2 (EBR II) operated by the University of Chicago for the Chicago Operations Office (AEC). Met with:

Mr. Earl Graham, Health Physicist;
Mr. Joseph Auer, Plant Services Manager.

Afternoon:

Visit to the Special Power Excursion Reactor Test Area (SPERT) operated by the Phillips Petroleum Company. Three facilities were visited: SPERT-IV reactor, SPERT-III reactor, and Power Burst Facility (PBF). The tour was conducted by Mr. Armand Cordes, Health Physicist.

October 17

Morning:

Visit to the Idaho Chemical Processing Plant (CPP) operated by Idaho Nuclear Corporation. Discussions were held with Messrs. R. E. Hayden, Health Physicist, Charles B. Amberson, and Mr. Coward, Idaho Nuclear Corporation, and Mr. Donald Deming of the Atomic Energy Commission.

Afternoon:

1. Discussion and tour of the Waste Calcining Facility (Mr. George Lohse);

2. Tour of the sewage treatment facility at the Central Facilities Area (Mr. Coward).

October 18

Morning:

Visit to the Test Reactor Area (TRA) operated by the Idaho Nuclear Corporation. Tour and discussion by Mr. John F. Sommers, Radiation Supervisor.

Afternoon:

Visit to the Test Area North (TAN) which is largely the operational responsibility of the Idaho Nuclear Corporation. (The Phillips Petroleum Company will be responsible for the Loss-of-fluid Test which is to be conducted at the Field Engineering Test Facility). Met with Mr. J. Sommers and Mr. Donald Reed and several members of Mr. Reed's staff.

October 21

General discussions with the following individuals:

1. Atomic Energy Commission:

   Dr. G. L. Voelz
   Mr. J. T. Collins
   Dr. C. A. Pelletier
   Mr. B. L. Schmalz
   Dr. Will Polzer, Soil Scientist

2. U. S. Geological Survey

   Mr. J. T. Barraclough, Chief, Research Project
   Mr. John B. Robertson, Hydrologist

October 22

Morning:

FWPCA representatives spent the morning in the following manner:

1. Dr. M. W. Lammering--conferred with Mr. J. Collins and attended Health Services Laboratory seminar;

2. Mr. R. J. Velten--conferred with Mr. C. Sill on analytical methodology;

3. Mr. J. Sceva--conferred with Mr. J. Barraclough and Mr. Robertson.

Afternoon:

Brief meeting with Mr. W. L. Ginkel and members of his staff at the Idaho Operations Office.

APPENDIX B

RULES AND REGULATIONS FOR STANDARDS OF WATER QUALITY AND FOR WASTE WATER TREATMENT FOR WATERS OF THE STATE OF IDAHO

RULES AND REGULATIONS
FOR THE ESTABLISHMENT OF STANDARDS OF WATER QUALITY AND FOR WASTE WATER TREATMENT REQUIREMENTS FOR WATERS OF THE STATE OF IDAHO

LEGAL AUTHORITY

The Idaho State Board of Health, pursuant to the authority granted in Title 39, Chapter 1, Idaho Code, sections 39-105 and 39-112, did adopt the following Rules and Regulations for the Establishment of Standards of Water Quality and for Waste Water Treatment Requirements for Waters of the State of Idaho while in regular quarterly session on August 15, 1968, at Coeur d'Alene, Idaho, and did determine the effective date to be September 4, 1968.

PREAMBLE

It shall be the policy of the State Board of Health to provide for an orderly and economically feasible comprehensive water pollution control program, which program shall be administered to conserve the waters of the State for all legitimate beneficial uses, including uses for domestic purposes, agriculture, industry, recreation, and fish and wildlife propagation.

The Board recognizes that the control of water pollution involves many factors, including multiple water uses, economic considerations and overall benefits to the citizens of the State. It shall be the policy of the Board to carry out such a program on a cooperative voluntary and educational basis insofar as such a policy is compatible with statutory duties of the Board.

The Department of Health shall, on the basis of necessary technical studies, determine waste treatment needs throughout the State and shall establish recommended time tables for the provision of such treatment facilities as will be necessary to abate pollution of the waters of the State.

These regulations are intended to be in harmony with existing interstate stream regulations and as an administrative guide for the continuation and supplementation of the program previously carried out by the Board. The regulations are general in nature and are intended for use until such time as the staff of the Department of Health may be able to gather sufficient data to determine more precise quality standards for such individual streams as uses may indicate and until such time as the staff of the Department develops the capability of initiating a permit system as provided in the Idaho statutes.

For these reasons, paragraph 3A should be considered as the basic working arrangement of the water pollution control program which provides, in effect, special consideration for each and every waste source on the basis of special problems peculiar to that source.

DEFINITIONS

The following definitions shall apply to the interpretation and the enforcement of these regulations:

"Sewage" means the water-carried human or animal waste from residences, buildings, industrial establishments or other places together with such ground

water infiltration and surface water as may be present. The admixture with sewage as above defined of industrial wastes or wastes, as defined in the following paragraphs 2 and 3, shall also be considered "sewage."

"Industrial waste" means any liquid, gaseous, radioactive or solid waste substance or a combination thereof resulting from any process of industry, manufacturing, trade or business, or from the development or recovery of any natural resources.

"Wastes" means sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive or other substances which will or may cause pollution or tend to cause pollution of the public waters of the State.

"Pollution" means such contamination or other alteration of the physical, chemical or biological properties of the public waters of the State, including change in temperature, taste, color, turoidity or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into the waters of the State which either by itself or in connection with any other substance present, will or can reasonably be expected to create a public nuisance or render such waters harmful, detrimental or injurious to public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate uses or to livestock, wildlife, fish or other aquatic life or the habitat thereof.

"Standard" or "standards" means such measure of quality or purity in relation to their reasonable and necessary use as may be established by the State Board of Health.

1. WATER RIGHTS

It shall be the policy of the State Board of Health that the adoption of water quality standards and regulations and the enforcement of such standards and regulations is not intended to conflict with the apportionment of water to the State of Idaho, to any of the interstate compacts or court decrees, or to interfere with the rights of Idaho appropriators in the utilization of water rights.

2. HIGHEST AND BEST PRACTICABLE TREATMENT AND CONTROL REQUIRED

Notwithstanding the water quality standards contained herein, where a higher standard can be achieved, the highest and best practicable treatment and/or control of wastes, activities and flows shall be provided so as to maintain dissolved oxygen at the highest desirable levels and overall water quality as good as practicable, and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor and other deleterious factors at the lowest desirable levels.

3. RESTRICTIONS ON THE DISCHARGE OF SEWAGE AND INDUSTRIAL WASTES AND HUMAN ACTIVITIES WHICH AFFECT WATER QUALITY IN THE WATERS OF THE STATE

A. No wastes shall be discharged and no activities shall be conducted in such a way that said wastes or activities either alone or in combination

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with other wastes or activities will violate or can reasonably be expected to violate the water quality standards and/or regulations contained herein.

B. It is noted that from time to time certain short-term activities which are deemed necessary to accommodate essential activities and protect the public interest may be specially authorized by the Department of Health under such conditions as the Department of Health may prescribe even though such activities may result in a reduction of water quality conditions below those criteria and classifications established by this regulation.

4. MAINTENANCE OF STANDARDS OF QUALITY

A. The degree of sewage or waste treatment required to restore and/or maintain the standards of quality and/or maintain existing quality shall be determined in each instance by the State Board of Health and shall be based upon the following:

(1) The uses which are or may likely be made of the receiving stream.

(2) The size and nature of flow of the receiving stream.

(3) The quantity and quality of the sewage or wastes to be treated.

(4) The presence or absence of other sources of pollution on the same watershed.

B. For purposes of enforcement of these standards and regulations, sampling will be done at a point where these standards and/or regulations can be evaluated, except for areas immediately adjacent to outfalls. Cognizance will be given to the opportunity for admixture of waste effluents with receiving waters, where such admixing is planned and carried out in a manner that will provide minimum degradation to receiving waters.

5. GENERAL WATER QUALITY STANDARDS FOR WATERS OF THE STATE

The following general water quality standards will apply to waters of the State, both surface and underground, in addition to the water quality standards set forth on specifically identified waters. Waters of the State shall not contain:

A. Toxic chemicals of other than natural origin in concentrations found to be of public health significance or to adversely affect the use indicated. (Guides such as the Water Quality Criteria, published by the State of California Water Quality Control Board (Second Edition, 1963) will be used in evaluating the tolerances of the various toxic chemicals for the use indicated.)

B. Deleterious substances of other than natural origin in concentrations that cause tainting of edible species or tastes and odors to be imparted to drinking water supplies.

C. Radioactive materials or radioactivity in water which exceed (1) 1/30th of the MPC values given in Column 2, Table I, Appendix A, Part C, Rules and Regulations for the Control of Radiation in the State of Idaho, (2) exceeds concentration limits of the Idaho Drinking Water Standards for waters used for, or likely to be used for, domestic supplies, (3) results in accumulations of radioactivity in edible plants and animals that present a hazard to consumers, and/or (4) is harmful to aquatic life.

D. Floating or submerged matter not attributable to natural causes.

E. Excess nutrients of other than natural origin that cause visible slime growths or other nuisance aquatic growths.

F. Visible concentrations of oil, sludge deposits, scum, foam or other wastes that may adversely affect the use indicated.

G. Objectionable turbidity which can be traced to a point source or sources.

ON THE BASIS OF THE PRECEDING GENERAL WATER QUALITY STANDARDS, THE FOLLOWING NUMERICAL STANDARDS, WHERE APPLICABLE, SHALL BE APPLIED, EXCEPT WHERE DIFFERENCES OCCUR BETWEEN NUMERICAL STANDARDS CONTAINED HEREIN AND THOSE PREVIOUSLY ADOPTED FOR SPECIFICALLY IDENTIFIED INTERSTATE STREAMS. IN SUCH CASES, STANDARDS FOR INTERSTATE STREAMS SHALL APPLY.

6. NO WASTES SHALL BE DISCHARGED AND NO ACTIVITIES SHALL BE CONDUCTED WHICH EITHER ALONE OR IN COMBINATION WITH OTHER WASTES OR ACTIVITIES WILL CAUSE IN THESE WATERS:

A. Organisms of the Coliform Group where Associated with Fecal Sources

(MPN, equivalent MF or appropriate test using a representative number of samples.) Average concentrations of coliform bacteria to exceed 1,000 per 100 milliliters, with 20 percent of samples not to exceed 2,400 per 100 milliliters.

B. Dissolved Oxygen (DO)

DO to be less than 75 percent of saturation at seasonal low or less than 100 percent saturation in spawning areas during spawning, hatching, and fry stages of salmonid fishes.

C. Hydrogen Ion Concentration (pH)

pH values to be outside the range of 6.5 and 9.0. Induced variation not to be more than 0.5 pH unit.

D. Temperature

Any measurable increases when stream temperatures are 68° F. or above, or more than 2° F. increase when stream temperatures are 66° F. or less.

E. Turbidity

Turbidity, other than of natural origin, to exceed 10 Jackson Turbidity Units (JTU). (This turbidity requirement shall not be deemed to rigidly apply to streams, drain ditches, etc., receiving irrigation return flow. However, every reasonable effort should be made to prevent excessive turbidity from such wastes.)

IN ADDITION TO THE GENERAL STANDARDS CONTAINED HEREIN, THE FOLLOWING NUMERICAL STANDARDS SHALL APPLY TO THOSE WATERS OF THE STATE WHICH ARE PRESENTLY UPSTREAM FROM EXISTING SIGNIFICANT WASTE SOURCES AND TO ALL LAKES AND RESERVOIRS USED PRIMARILY FOR RECREATION, DRINKING WATER SUPPLIES, FISH AND WILDLIFE PROPOGATION AND/OR AESTHETIC PURPOSES.

7. NO WASTES SHALL BE DISCHARGED AND NO ACTIVITY SHALL BE CONDUCTED WHICH ALONE OR IN COMBINATION WITH OTHER WASTES WILL CAUSE IN THESE WATERS:

A. Organisms of the Coliform Group

Average concentration of coliform bacteria to exceed 240 per 100 milliliters with 20 percent of the samples not to exceed 1,000 per 100 milliliters and fecal coliform not to exceed 50 per 100 milliliters with 20 percent of the samples not to exceed 200 per 100 milliliters.

B. Dissolved Oxygen (DO)

DO to be less than 75 percent of saturation at seasonal low or less than 100 percent saturation in spawning areas during spawning, hatching, and fry stages of salmonid fishes.

C. Hydrogen Ion Concentration (pH)

pH values to be outside the range of 6.5 to 9.0. Induced variation not to be more than 0.5 pH unit.

D. Temperature

Any measurable increase when stream temperatures are 66° F. or above, or more than 2° F. increase when stream temperatures are 64° F. or less.

E. Turbidity

Turbidity, other than of natural origin, to exceed 5 Jackson Turbidity Units (JTU).

F. Phosphorus or Nitrogen Compounds

Measurable concentration of phosphorus or nitrogen compounds above those of natural origin.

8. REGULATIONS GOVERNING WASTE DISCHARGES

A. Any person or persons, corporation, officers of any municipality, sewer district or association which owns or operates any facility or carries

out any operation which results in the discharge of waste water shall furnish to the Department of Health such information concerning quality and quantity of discharged waste waters and maintain such treatment records as the Department may reasonably require to evaluate the effects on any receiving waters.

B. For the purposes of these regulations, minimum adequate treatment for domestic sewage or industrial wastes containing significant organic material shall be equal to that which is commonly known as secondary treatment or the equivalent of 85 percent removal of the biochemical oxygen demand including adequate disinfection of any wastes which may contain organisms that may produce disease in man or animals. In industrial processes, in-plant process controls or alterations, carried out for the primary purpose of waste reduction, shall be considered as a part of the treatment process. Exceptions to secondary treatment requirements may be made by the Department of Health when it can be demonstrated that such exceptions will not adversely affect classified water quality and will offer adequate protection for all beneficial uses. Failure to provide adequate treatment shall be considered a violation of these regulations.

C. Any person, persons, corporation or officials of a municipality or sewer district who owns or operates any sewage or other water-borne waste treatment facility shall at all times operate such facility under reasonably competent supervision and with the highest efficiency that can reasonably be expected and shall maintain such facility in good repair.

D. In cases of subsurface sewage or waste disposal, such disposal facilities shall be so located that such sources of pollution including bacteriological, organic or inorganic nutrient pollution will not or will not be likely to enter adjacent waters. In no case shall any portion of such disposal system be located closer than 50 feet horizontally from the edge of any water course, including lakes or reservoirs, as determined from the known highest water level of such water course, lake or reservoir. Improperly or inadequately treated sewage shall not be allowed to accumulate on the ground surface in such a manner that it may create a health hazard.

E. It shall be a violation of these regulations to store, dispose of, or allow to accumulate any deleterious material adjacent to or in the immediate vicinity of any portions of the waters of the State in such a manner that such material will or is likely to enter the stream at times of high water or runoff or where drainage from such materials or accidental failure of storage facilities may transport or allow deleterious material into the water course. Such materials shall include, but not be limited to, trash, rubbish, garbage, oil, gasoline, chemicals, sawdust and accumulations of manure.

F. In case of accidental spills of deleterious materials, persons in responsible charge shall make every reasonable effort to contain spilled material in such a manner that it will not contaminate or pollute any waters of the State, and shall immediately notify the Department of Health of any such spills.

G. Sewage sludge or solid material which may contain disease-producing organisms, when applied to lawns, root crop fields or fields producing foods which may be consumed raw, or otherwise used in such a manner that exposure to persons may be a health hazard, shall be heated to 135° F. or higher for a period of one hour or any equivalent combination of time and temperature approved by the Department of Health before such use.

H. Waste discharges to underground waters shall receive, prior to discharge of such wastes, such treatment as is necessary to render them equal in quality to existing underground waters or such treatment as is necessary to bring such discharge into conformance with the Idaho Drinking Water Standards. The provisions of Paragraph 8H will not be considered as strictly applicable to the existing sink wells used exclusively for irrigation waste water disposal where such disposal does not adversely affect domestic water sources. However, it should be recognized that the long-term preservation of Idaho's vast underground water resources is of great importance and that every reasonable effort should be made to reduce pollution from this source and that a long-term research and development program should be established that will lead to the total elimination of disposal wells that directly affect underground aquifers that are not subject to adequate filtration and percolation to eliminate significant pollution.

Further, this paragraph shall not be construed to preclude the use of deep disposal wells which may be constructed to discharge into underground water strata whose quality is such that it is not likely to be used for other beneficial purposes, provided necessary precautions are taken to prevent contamination of usable aquifers.

I. Sewage Treatment Design Standards and Subsurface Sewage Disposal Standards, as adopted by the Idaho Department of Health, shall be revised from time to time and shall be used as a guide in the review of plans and specifications for waste treatment facilities as required by Section 39-112, Idaho Code.

Regulations relating to Water Pollution Control adopted by the Idaho State Board of Health May 11, 1959, are hereby rescinded.

These Regulations shall be in full force and effect on and after September 4, 1968.

Section 39-112, Par. E --All plans and specifications for the construction of new sewage systems, sewage treatment or disposal plants or systems, or other waste treatment, or disposal facilities, or for improvement or extensions to existing sewerage systems or sewage treatment or disposal plants, shall be submitted to and be approved by the board, before construction thereof may begin.

APPENDIX C

EXCERPT FROM

IDAHO DRINKING WATER STANDARDS

IDAHO DRINKING WATER STANDARDS

In accordance with the provisions of Idaho statutes pertaining to the protection of domestic water supplies (Sections 37-2102, 54-1213 and 39-101, as amended, Idaho Code), the following standards for chemical, physical and bacterial purity and standards for protection from impurities of water supplies in the state are promulgated by the Department of Health.

Section 37-2102. (as amended) Domestic Water to be Protected. -- Any person or persons, corporation or corporations or officers of a municipality, owning or maintaining any plant or system for the supply to the inhabitants of this State, or any part thereof, of water for domestic purposes shall protect the same and keep it free from all impurities and all other foreign substances which tend to injure the health of the ultimate consumers of such water, whether such impurities or foreign substances are chemical or bacterial. The standards for protection from impurities and the standards for chemical and bacterial purity in the State of Idaho shall be promulgated annually by the Department of Public Health and shall be consistent with this section and the Drinking Water Standards of the U. S. Public Health Service, which standards are suitable for use in evaluating the quality and safety of water and water supply systems. The Department of Public health may in its discretion issue reports and post public signs indicating compliance with these standards.

Section 54-1213 (as amended) Public Work. -- After the first day of January, 1940, it shall be unlawful for this state, or for any county, city, village, district, or other subdivision of the state, having power to levy taxes or assessments against property situated therein, to engage in the construction of any public work involving professional engineering unless the plans and specifications and estimates have been prepared by, and the construction executed under the direct supervision of a registered professional engineer.

Section 39-101 (as amended) (Paragraph 4, Subparagraphs 13 A, B, and D) State Board of Health -- Powers and Duties. -- All of the powers and duties of the Department of Public Health are hereby transferred to the State Board of Health and the State Board of Health shall have all of such powers and shall have and exercise the following powers and duties in additiona to all other powers and duties imposed on it by law:

(13) To establish and enforce minimum sanitary standards for:

A. The collection, treatment and distribution of drinking water, including sanitary supervision, regulation and control of the construction, extension, operation and maintenance of public water supply, collection, treatment and distribution systems and approval of plans covering the construction and extension of such systems.

B. The quality of water supplied to the public and as to the quality of the effluent of sewerage system, sewage treatment plants and discharged upon the land or into the surface or ground waters.

D. The protection of water sheds used for public water supplies.

Definition of Terms -- For the purpose of these Standards the terms designated herein below shall be defined as follows:

Adequate protection by natural agencies is rarely possible in surface waters. It is possible in the case of ground waters and includes protection by storage in and percolation through water-bearing materials.

Artificial treatment includes the various processes commonly used in water treatment, both separately and in combination, such as storage, aeration, sedimentation, coagulation, rapid or slow sand filtration, chlorination, and other accepted forms of disinfection. Rapid sand filtration treatment is commonly understood to include those auxiliary measures, notably coagulation and sedimentation, which are essential to its proper operation.

Adequate protection by artificial treatment implies that the method and degree of elaboration of treatment are appropriate to the source of supply; that the works are of adequate capacity to support maximum demands, are well located, designed, and constructed, are carefully and skillfully operated and supervised by properly trained and qualified personnel, and are adequately protected against floods and other sources of pollution. The evidence that the protection thus afforded is adequate must be furnished by frequent bacteriological examinations and other appropriate analyses showing that the purified water is of good and reasonably uniform quality, a recognized principle being that irregularity in quality is an indication of potential danger. A minimum specification of good quality would be conformance to the bacteriological and chemical requirements of these Standards, as indicated in Sections 3 and 4.

Sanitary defect means any faulty structural condition, whether of location, design, or construction, treatment, or distribution works which may regularly or occasionally prevent satisfactory purification of the water supply or cause it to be contaminated from extraneous sources. Among the extraneous sources of

contamination of water supply are dual supplies, bypasses, cross-connections, inter-connections, and backflow connections.

Health hazard means any faulty operating condition including any device or water treatment practice, which, when introduced into the water supply system, creates or may create a danger to the well-being of the consumer.

Water supply system includes the works and auxiliaries for collection, treatment, and distribution of the water from the source of supply to the free-flowing outlet of the ultimate consumer.

The coliform group of bacteria is defined, for the purpose of these standards, as including all organisms considered in the coli-aerogenes group as set forth in the Standard Methods for the Examination of Water and Sewage, current edition, prepared, approved, and published jointly by the American Public Health Association and the American Water Works Association, New York City. The procedures for the demonstration of bacteria of this group shall be those specified herein, for:

(a) The completed test, or

(b) The confirmed test when the liquid confirmatory medium brilliant green bile lactose broth, 2 percent, is used, providing the formation of gas in any amount in this medium during 48 hours of incubation at 37° C. is considered to constitute a positive confirmed test, or

(c) The confirmed test when one of the following liquid confirmatory media is used: Crystal violet lactose broth, fuchsin lactose broth, or formate ricinoleate broth. For the purpose of this test, all are equivalent, but it is recommended that the laboratory worker base his selection of any one of these confirmatory media upon correlation of the confirmed results thus obtained with a series of completed tests, and that he select for use the liquid confirmatory medium yielding

results most nearly agreeing with the results of the completed test. The incubation period for the selected liquid confirmatory medium shall be 48 hours at 37° C. and the formation of gas in any amount during this time shall be considered to constitute a positive confirmed test.

(d) The membrane filter technique as outlined in the Standard Methods.

The Standard portion of water for the application of the bacteriological test shall be ten milliliter (10 ml.)

The standard sample for the bacteriological test shall consist of five (5) standard portions of ten milliliter (10 ml.).

In any disinfected supply the sample must be freed of any disinfecting agent within twenty (20) minutes of the time of its collection.

SOURCE, PROTECTION AND OPERATION STANDARDS

1.1 The water supply shall be obtained from the most desirable source which is feasible and effort shall be made to prevent or control pollution of the source. If the source is not adequately protected by natural means, the supply shall be adequately protected by treatment.

1.2 Frequent sanitary surveys shall be made by the purveyor of the water supply system to locate and identify health hazards which might exist in the system. The manner and frequency of making these surveys and the rate at which discovered health hazards are to be removed shall be in accordance with a program approved by the Department of Health.

2. Approval of water supplies shall be dependent in part upon:

2.1 Enforcement of rules and regulations to prevent development of health hazards.

2.2 Adequate protection of the water quality throughout all parts of the system, including watersheds and underground sources, as demonstrated by frequent surveys.

2.3 Proper operation of the water supply system under the responsible charge of personnel whose qualifications are acceptable to the Department of Health.

2.4 Adequate capacity of the system to meet peak demands without development of low pressures or other health hazards.

2.5 Satisfactory record of laboratory examinations showing consistent compliance with the water quality requirements of these standards.

2.6 Satisfactory submission of prescribed water treatment records to the Department of Health if treatment is provided.

2.7 Submission and approval of engineering plans covering the construction and extension of the water supply, collection, treatment and distribution systems prior to actual construction.

3. For the purpose of application of these standards, responsibility for the conditions in and the operation of the water supply system shall be considered to be held by:

3.1 The water purveyor from the source of supply to the connection to the customer's service piping; and

3.2 The owner of the property served and the municipal, county, or other authority having legal jurisdiction from the point of connection to the customer's service piping to the free flowing outlet of the ultimate consumer.

WATER QUALITY STANDARDS

Part I. Bacteriological Quality

1.1 Sampling.

1.1.1 Compliance with the bacteriological requirements of these Standards shall be based on examinations of samples collected at representative points throughout the distribution system. The frequency of sampling and the location of sampling points shall be established by the Department of Health after investigation of the source, method of treatment, and protection of the water concerned.

1.1.2 The minimum number of samples to be collected from the distribution system and examined each month should be in accordance with the following table:

Population Served	Minimum Number of Samples Per Month from the Distribution System
3,000 and under	2
3,000 to 5,000	4
5,000 to 7,000	6
7,000 to 9,000	8
9,000 to 11,000	10
11,000 to 13,000	12
13,000 to 15,000	14
15,000 to 20,000	20
20,000 to 25,000	26
25,000 to 30,000	35
30,000 to 45,000	50
45,000 to 60,000	70

1.1.3 In determining the number of samples examined monthly, the following samples may be included, provided all results are assembled and

available for inspection and the laboratory methods and technical competence of the laboratory personnel are approved by the Department of Health:

(a) Samples examined by the Department of Health.

(b) Samples examined by local government laboratories.

(c) Samples examined by the water works authority.

(d) Samples examined by commercial laboratories.

1.1.4 The laboratories in which these examinations are made and the methods used in making them shall be subject to inspection at any time by the designated representatives of the Department of Health. Compliance with the specified procedures and the results obtained shall be used as a basis for certification of the supply.

1.1.5 Daily samples collected following a bacteriologically unsatisfactory sample as provided in Section 1.2.1 shall be considered as special samples and shall not be included in the total number of samples examined. Neither shall such special samples be used as a basis for prohibiting the supply, provided that: (1) When waters of unknown quality are being examined, simultaneous tests are made on multiple portions of a geometric series to determine a definitive coliform content; (2) Immediate and active efforts are made to locate the cause of pollution; (3) Immediate action is taken to eliminate the cause; and (4) Samples taken following such remedial action are satisfactory.

1.2 Limits.--The presence of organisms of the coliform group as indicated by samples examined shall not exceed the following limits:

1.2.1 When 10 ml standard portions are examined, not more than 10 percent in any month shall show the presence of the coliform group. The presence of the coliform group in three or more 10 ml portions of a standard

sample shall not be allowable if this occurs:

(a) In two consecutive samples;

(b) In more than one sample per month when less than 20 are examined per month; or

(c) In more than 5 percent of the samples when 20 or more are examined per month.

When organisms of the coliform group occur in 3 or more of the 10 ml portions of a single standard sample, daily samples from the same sampling point shall be collected promptly and examined until the results obtained from at least two consecutive samples show the water to be of satisfactory quality.

PART II. Physical Characteristics

2.1 Sampling.--The frequency and manner of sampling shall be determined by the Department of Health. Under normal circumstances samples should be collected one or more times per week from representative points in the distribution system and examined for turbidity, color, threshold, odor, temperature and taste.

2.2 Limits.--Drinking water should contain no impurity which would cause offense to the sense of sight, taste, or smell. Under general use, the following limits should not be exceeded:

Turbidity	5 units
Color	15 units
Threshold Odor Number	3

Part III. Chemical Characteristics

3.1 Sampling.

3.1.1 The frequency and manner of sampling shall be determined by the Department of Health. Under normal circumstances, analyses for

substances listed below need be made only annually. If, however, there is some presumption of unfitness because of the presence of undesirable elements, compounds, or materials, periodic determinations for the suspected toxicant or material, should be made more frequently and an exhaustive sanitary survey should be made to determine the source of the pollution. Where the concentration of a substance is not expected to increase in processing and distribution, available and acceptable source water analyses performed in accordance with standard methods may be used as evidence of compliance with these Standards.

3.1.2 Where experience, examination, and available evidence indicate that particular substances are consistently absent from a water supply or below levels of concern, annual examinations for those substances may be omitted when approved by the Department of Health.

3.2 Limits. -- Drinking water shall not contain impurities in concentrations which may be hazardous to the health of the consumers. It should not be excessively corrosive to the water supply system. Substances used in its treatment shall not remain in the water in concentrations greater than required by good practice. Substances which may have deleterious physiological effect, or for which physiological effects are not known, shall not be introduced into the system in a manner which would permit them to reach the consumer.

3.2.1 The following chemical substances should not be present in a water supply in excess of the listed concentrations where, in the judgment of the Department of Health, other more suitable supplies are or can be made available.

Substance	Concentration in mg/l
Alkyl Benzene Sulfonate (ABS)	0.5
Arsenic (As)	0.01
Chloride (Cl)	250.
Copper (Cu)	1.
Carbon Chloroform Extract (CCE)	0.2
Cyanide (CN)	0.01
Fluoride (F)	(See 3.2.3)
Iron (Fe)	0.3
Manganese (Mn)	0.05
Nitrate[1] (NO_3)	45.
Phenols	0.001
Sulfate (SO_4)	250.
Total Dissolved Solids	500.
Zinc (Zn)	5.

1 In areas in which the nitrate content of water is known to be in excess of the listed concentration, the public should be warned of the potential dangers of using the water for infant feeding.

3.2.2 The presence of the following substances in excess of the concentrations listed shall constitute grounds for rejection of the supply:

Substance	Concentration in mg/l
Arsenic (As)	0.05
Barium (Ba)	1.0
Cadmium (Cd)	0.05
Chromium (Hexavalent (Cr +6)	0.05
Cyanide (CN)	0.2
Fluoride (F)	(See 3.2.3)
Lead (Pb)	0.05
Selenium (Se)	0.01
Silver (Ag)	0.05

3.2.3 Fluoride.--When fluoride is naturally present in drinking water, the concentration should not average more than the appropriate upper limit in Table I. Presence of fluoride in average concentrations greater than two times the optimum values in Table I shall constitute grounds for rejection of the supply. Where fluoridation (supplementation of fluoride in drinking water) is practiced, the average fluoride concentration shall be kept within the upper and lower control limits in Table I.

Table 1.

Annual Average of Maximum Daily Air Temperatures[1]	Recommended control limits--Fluoride concentrations in mg/l		
	Lower	Optimum	Upper
50.0-53.7----------	0.9	1.2	1.7
53.8-58.3----------	0.8	1.1	1.5
58.4-63.8----------	0.8	1.0	1.3
63.9-70.6----------	0.7	0.9	1.2
70.7-79.2----------	0.7	0.8	1.0
79.3-90.5----------	0.6	0.7	0.8

1 Based on temperature data obtained for a minimum of five years.

In addition to the sampling required by paragraph 3.1, fluoridated and defluoridated supplies shall be sampled with sufficient frequency to determine that the desired fluoride concentration is maintained.

Part IV. Radioactivity

4.1 Sampling.

4.1.1 The frequency of sampling and analysis for radioactivity shall be determined by the Department of Health after consideration of the likelihood of significant amounts being present. Where concentrations of Ra^{226} or Sr^{90} may vary considerably, quarterly samples composited over a period of three months are recommended. Samples for determination of gross activity should be taken and analyzed more frequently.

4.1.2 As indicated in paragraph 3.1, data from acceptable sources may be used to indicate compliance with these requirements.

4.2 Limits.

4.2.1 The effects of human radiation exposure are viewed as harmful and any unnecessary exposure to ionizing radiation should be avoided. Approval of water supplies containing radioactive materials shall be based upon the judgment that the radioactivity intake from such water supplies when added to that from all other sources is not likely to result in an intake greater than the radiation protection guidance recommended by the Federal

Radiation Council. Water supplies shall be approved without further consideration of other sources of radioactivity intake of Radium-226 and Strontium-90 when the water contains these substances in amounts not exceeding 3 and 10 PC/liter, respectively. When these concentrations are exceeded, a water supply may be approved by the Department of Health if surveillance of total intakes of radioactivity from all sources indicates that such intakes are within the limits recommended by the Department of Health and the Federal Radiation Council for control action.

4.2.2 In the known absence of Strontium-90 and alpha emitters, the water supply is acceptable when the gross beta concentrations do not exceed 1,000 PC/liter. Gross beta concentrations in excess of 1,000 PC/liter shall be grounds for rejection of supply except when more complete analyses indicates that concentrations of nuclides are not likely to cause exposure greater than the Radiation Protection Guides.

Part V. Recommended Analytical Methods

5.1 Analytical methods to determine compliance with the requirements of these Standards shall be those specified in Standard Methods for the Examination of Water and Wastewater, American Public Health Association, current edition and those specified as follows.

5.2 Barium--Methods for the Collection and Analysis of Water Samples, Water Supply Paper No. 1454, Rainwater, F. H. and Thatcher, L. L., U. S. Geological Survey, Washington, D. C.

5.3 Carbon Chloroform Extract (CCE)--Manual for Recovery and Identification of Organic Chemicals in Water, Middleton, F. M., Rosen, A. A., and Burttschell, R. H., Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio, Tentative Method for Carbon Chloroform

PART I - SUBMISSION OF PLANS

1.0 GENERAL. - All reports, final plans, and specifications should be submitted at least 30 days prior to the date on which action by the Idaho Department of Health is desired. Documents submitted for formal approval shall include (a) general layout, (b) detailed plans, (c) specifications, (d) reference to any plans and specifications previously filed with the Idaho Department of Health pertaining to the water supply system involved. No approval for construction can be issued until final, complete, detailed plans and specifications prepared by a registered professional engineer /have been submitted to the Idaho Department of Health and found to be satisfactory.

1.1 ENGINEER'S REPORT. - The engineer's report for water works improvements shall, where pertinent, present the following information:

1.1.1 General Information. - Describe the existing water works and sewerage facilities, and describe briefly the municipality or water district served.

1.1.2 Extent of Water Works System. - Describe the nature and extent of the area to be served with water, and any provisions for extending the water works system to include additional areas, and appraise the future requirements for service. Also, describe significant industrial developments and industrial water supply needs which are to be met by the water supply system, or which are likely to be required in the near future.

1.1.3 Alternate Plans. - Where two or more solutions exist for providing public water supply facilities, each of which is feasible and practicable, discuss the alternate plans and give reasons for selecting the one recommended, including financial considerations.

1.1.4 Soil, Ground Water Conditions, and Foundation Problems. - Describe

Extract (CCE) in Water, J. Am. Water Works A. 54:223-227, Feb. 1962.

5.4 Radioactivity - Laboratory Manual of Methodology, Radionuclide Analysis of Environmental Samples, Technical Report R59-6, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio; and Methods of Radiochemical Analysis Technical Report No. 173, Report of the Joint WHO-FAO Committee, 1959, World Health Organization.

5.5 Selenium - Suggested Modified Method for Colorimetric Determination of Selenium in Natural Water, Magin, G. B. Thatcher, L. L. Rattig, S., and Lavine, H., J. Am. Water Works Assoc. 52, 1199 (1960).

5.6 Organisms of the coliform group - All of the details of techniques in the determination of bacteria of this group, including the selection and preparation of apparatus and media, the collection and handling of samples and the intervals and conditions of storage allowable between collection and examination of the water sample, shall be in accordance with Standard Methods for the Examination of Water and Wastewater, current edition, and the procedures shall be those specified therein for:

5.6.1 The Membrane Filter Technique, Standard Test, or

5.6.2 The Completed Test, or

5.6.3 The Confirmed Test, procedure with brilliant green lactose bile broth, or

5.6.4 The Confirmed Test, procedure with Endo or eosin methylene blue agar plates.

APPENDIX D

EXCERPT FROM

RULES AND REGULATIONS FOR THE CONTROL OF RADIATION IN THE STATE OF IDAHO

WASTE DISPOSAL

Sec. C.301 General Requirement. No licensee shall dispose of any radioactive material except:

(a) By transfer to an authorized recipient as provided in Part B, or
(b) As authorized pursuant to Sections C.302, C.303, C.304, or C.106.

Sec. C.302 Method of Obtaining Approval of Proposed Disposal Procedures. Any person may apply to the Board for approval of proposed procedures to dispose of radioactive material in a manner not otherwise authorized in this part. Each application shall include a description of the radioactive material, including the quantities and kinds of radioactive material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application, where appropriate, should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meterological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures. The Board will not approve any application for a license to receive radioactive material from other persons for disposal on land not owned by a state or the Federal Government.

Sec. C.303 Disposal by Release into Sanitary Sewerage Systems. No licensee shall discharge radioactive material into a sanitary sewerage system unless:

(a) It is readily soluble or dispersible in water; and,
(b) The quantity of any radioactive material released into the system by the licensee in any one day does not exceed the larger of subparagraphs (1) or (2) of this paragraph:
(1) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration not greater than the limits specified in Appendix A, Table I, Column 2, of this part; or,
(2) Ten times the quantity of such material specified in Appendix B of this part; and,
(c) The quantity of any radioactive material released in any one month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in Appendix A, Table I, Column 2, of this part; and,
(d) The gross quantity of radioactive material released into the sewerage system by the licensee does not exceed one curie per year.

Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this section.

Sec. C.304 Disposal by Burial in Soil. No licensee shall dispose of radioactive material by burial in soil unless:

(a) The total quantity of radioactive materials buried at any one location and time does not exceed, at the time of burial, 1,000 times the amount specified in Appendix B of this part; and,
(b) Burial is at a minimum depth of four feet; and,
(c) Successive burials are separated by distances of a least six feet and not more than 12 burials are made in any year.

Sec. C.305 Disposal by Incineration. No licensee shall incinerate radioactive material for the purpose of disposal or preparation for disposal except as specifically approved by the Board pursuant to Sections C.106 and C.302.

RECORDS, REPORTS, AND NOTIFICATION

Sec. C.401 Records of Surveys, Radiation Monitoring, and Disposal.

(a) Each licensee or registrant shall maintain records showing the radiation exposure of all individuals for whom personnel monitoring is required under Section C.202 of this part. Such records shall be kept on Department of Health Form "Z", in accordance with the instructions contained in that form or on clear and legible records containing all the information required by Department of Health Form "Z". The doses entered on the forms or records shall be for periods of time not exceeding one calendar quarter.

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(b) Each licensee or registrant shall maintain records in the same units used in this part, showing the results of surveys required by C.201(b), and disposals made under Sections C.302, C.303, and C.304.

(c) Records of individual radiation exposure which must be maintained pursuant to the provisions of paragraph (a) of this section shall be preserved until such time as this Board may determine.[10] (Records which must be maintained pursuant to this part may be maintained in the form of microfilm.)

(d) The discontinuance of or curtailment of activities, does not relieve the licensee or registrant of responsibility for retaining all records required by this section. A licensee or registrant may, however, request the Board to accept such records. The acceptance of the records by the Board relieves the licensee or registrant of subsequent responsibility only in respect to their preservation as required by this section.

Sec. C.402 Reports of Theft or Loss of Source of Radiation. Each licensee or registrant shall report by telephone and telegraph to the Board the theft or loss of any source of radiation immediately after such occurrence becomes known.

Sec. C.403 Notification of Incidents.

(a) Immediate Notification. Each licensee or registrant shall immediately notify the Board by telephone and telegraph of any incident involving any source of radiation possessed by him and which may have caused or threatens to cause:

(1) Exposure to the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual to 150 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms of any individual to 375 rems or more of radiation; or,

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix A, Table II; or,

(3) A loss of one working week or more of the operation of any facilities affected; or,

(4) Damage to property in excess of $100,000.

(b) Twenty-four Hour Notification. Each licensee or registrant shall within 24 hours notify the Board by telephone and telegraph of any incident involving any source of radiation possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix A, Table II; or,

(3) A loss of one day or more of the operation of any facilities affected; or,

(4) Damage to property in excess of $1,000.

(c) Any report filed with the Board pursuant to this section shall be prepared in such a manner that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

Sec. C.404 Report to Former Employees and Others of Exposure to Radiation.

(a) A licensee or registrant, at the request of any individual formerly employed or associated with him (i.e., student, craftsman, etc.), shall furnish to such individual a report of his exposure to radiation as shown in records maintained pursuant to Section C.40(a). Such report shall be furnished within 30 days from the time the request is made; shall cover each calendar quarter of the individual's employment or association involving exposure to radiation, or such lesser period as may be requested by the individual. The report shall also include the results of

[10] At any time, the Board may amend this section to assure the further preservation of records which it determines should not be destroyed.

any calculations and analyses of radioactive material deposited in the body of the individual and made pursuant to the provisions of Section C.107. The report shall be in writing and contain the following statement:

"This report is furnished to you under the provisions of the Idaho State Board of Health regulations entitled Rules and Regulations for the Control of Radiation in the State of Idaho. You should preserve this report for future reference."

(b) The individual's request should include appropriate identifying data, such as social security number and dates and locations of employment or association.

Sec. C.405 Reports of Overexposures and Excessive Levels and Concentrations.

(a) In addition to any notification required by Section C.403, each licensee or registrant shall make a report in writing within 30 days to the Board of (1) each exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit as set forth in this part or as otherwise approved by the Board; (2) any incident for which notification is required by Section C.403; and (3) levels of radiation or concentrations of radioactive material (not involving excessive exposure of any individual) in an unrestricted area in excess of ten times any applicable limit as set forth in this part or as otherwise approved by the Board. Each report required under this paragraph shall describe the extent of exposure of individuals to radiation or to radioactive material; levels of radiation and concentrations of radioactive material involved; the cause of the exposure, levels, or concentrations; and corrective steps taken or planned to assure against a recurrence.

(b) In any case where a licensee or registrant is required pursuant to the provisions of this section to report to the Board any exposure of an individual to radiation or to concentrations of radioactive material, the licensee or registrant shall not later than the making of such report to the Board also notify such individual of the nature and extent of exposure. Such notice shall be in writing and shall contain the following statement:

"This report is furnished to you under the provisions of the Idaho State Board of Health regulations entitled Rules and Regulations for the Control of Radiation in the State of Idaho. You should preserve this report for future reference."

(c) Any report filed with the Board pursuant to this section shall be prepared in such a manner that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

Sec. C.406 Notice to Employees and Others of Exposure to Radiation. Each licensee or registrant, at the request of any individual employed or associated with him, shall advise such individual annually of the individual's exposure to radiation as shown in records maintained by the licensee or registrant pursuant to Section C.401(a).

Sec. C.407 Vacating Premises.

Each specific licensee shall, no less than 30 days before vacating or relinquishing possession or control of premises which may have been contaminated with radioactive material as a result of his activities, notify the Board in writing of intent to vacate. The Board may require that the licensee decontaminate or have decontaminated the location to a degree consistent with subsequent use as an unrestricted area, the details to be specified in each case by the Board.

PART C

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(See notes at end of appendix)

Element (Atomic Number)	Isotope		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
Actinium (89)	Ac 227	S	2×10^{-12}	6×10^{-5}	8×10^{-14}	2×10^{-6}
		I	3×10^{-11}	9×10^{-3}	9×10^{-13}	3×10^{-4}
	Ac 228	S	8×10^{-8}	3×10^{-3}	3×10^{-9}	9×10^{-5}
		I	2×10^{-8}	3×10^{-3}	6×10^{-10}	9×10^{-5}
Americium (95)	Am 241	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	6×10^{-4}	4×10^{-12}	2×10^{-5}
	Am 242 m	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	3×10^{-10}	3×10^{-3}	9×10^{-12}	9×10^{-5}
	Am 242	S	4×10^{-8}	4×10^{-3}	1×10^{-9}	1×10^{-4}
		I	5×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Am 243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	6×10^{-4}	4×10^{-12}	3×10^{-5}
	Am 244	S	4×10^{-6}	1×10^{-1}	1×10^{-7}	5×10^{-3}
		I	2×10^{-5}	1×10^{-1}	8×10^{-7}	5×10^{-3}
Antimony (51)	Sb 122	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
	Sb 124	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
		I	2×10^{-8}	7×10^{-4}	7×10^{-10}	2×10^{-5}
	Sb 125	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	3×10^{-3}	9×10^{-10}	1×10^{-4}
Argon (18)	A 37	Sub[2]	6×10^{-3}	------	1×10^{-4}	------
	A 41	Sub	2×10^{-6}	------	4×10^{-8}	------
Arsenic (33)	As 73	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	5×10^{-4}
		I	4×10^{-7}	1×10^{-2}	1×10^{-8}	5×10^{-4}
	As 74	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	1×10^{-7}	2×10^{-3}	4×10^{-9}	5×10^{-5}
	As 76	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	As 77	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	6×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Astatine (85)	At 211	S	7×10^{-9}	5×10^{-5}	2×10^{-10}	2×10^{-6}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
Barium (56)	Ba 131	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ba 140	S	1×10^{-7}	8×10^{-4}	4×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	2×10^{-5}
Berkelium (97)	Bk 249	S	9×10^{-10}	2×10^{-2}	3×10^{-11}	6×10^{-4}
		I	1×10^{-7}	2×10^{-2}	4×10^{-9}	6×10^{-4}
	Bk 250	S	1×10^{-7}	6×10^{-3}	5×10^{-9}	2×10^{-4}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Beryllium (4)	Be 7	S	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	1×10^{-6}	5×10^{-2}	4×10^{-8}	2×10^{-3}
Bismuth (83)	Bi 206	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	1×10^{-7}	1×10^{-3}	5×10^{-9}	4×10^{-5}
	Bi 207	S	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
		I	1×10^{-8}	2×10^{-3}	5×10^{-10}	6×10^{-5}
	Bi 210	S	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
		I	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Bi 212	S	1×10^{-7}	1×10^{-2}	3×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-2}	7×10^{-9}	4×10^{-4}
Bromine (35)	Br 82	S	1×10^{-6}	8×10^{-3}	4×10^{-8}	3×10^{-4}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Cadmium (48)	Cd 109	S	5×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
		I	7×10^{-8}	5×10^{-3}	3×10^{-9}	2×10^{-4}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(See notes at end of appendix)

Element (Atomic Number)	Isotope		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
	Cd 115 m	S	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
	Cd 115	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Calcium (20)	Ca 45	S	3×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Ca 47	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
Californium (98)	Cf 249	S	2×10^{-12}	1×10^{-4}	5×10^{-14}	4×10^{-6}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-3}
	Cf 250	S	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	3×10^{-3}
	Cf 251	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-3}
	Cf 252	S	2×10^{-11}	7×10^{-4}	7×10^{-13}	2×10^{-5}
		I	1×10^{-10}	7×10^{-4}	4×10^{-12}	2×10^{-5}
	Cf 253	S	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}
		I	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}
	Cf 254	S	5×10^{-12}	4×10^{-6}	2×10^{-13}	1×10^{-7}
		I	5×10^{-12}	4×10^{-6}	2×10^{-13}	1×10^{-7}
Carbon (6)	C 14	S	4×10^{-5}	2×10^{-2}	1×10^{-7}	8×10^{-4}
	(CO_2)	Sub	5×10^{-5}	------	1×10^{-6}	------
Cerium (58)	Ce 141	S	4×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	2×10^{-7}	3×10^{-3}	5×10^{-9}	9×10^{-5}
	Ce 143	S	3×10^{-7}	1×10^{-3}	9×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	Ce 144	S	1×10^{-8}	3×10^{-4}	3×10^{-10}	1×10^{-5}
		I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}
Cesium (55)	Cs 131	S	1×10^{-5}	7×10^{-2}	4×10^{-7}	2×10^{-3}
		I	3×10^{-6}	3×10^{-2}	1×10^{-7}	9×10^{-4}
	Cs 134 m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}
		I	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
	Cs 134	S	4×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}
		I	1×10^{-8}	1×10^{-3}	4×10^{-10}	4×10^{-5}
	Cs 135	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	9×10^{-8}	7×10^{-3}	3×10^{-9}	2×10^{-4}
	Cs 136	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
	Cs 137	S	6×10^{-8}	4×10^{-4}	2×10^{-9}	2×10^{-5}
		I	1×10^{-8}	1×10^{-3}	5×10^{-10}	4×10^{-5}
Chlorine (17)	Cl 36	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
		I	2×10^{-8}	2×10^{-3}	8×10^{-10}	6×10^{-5}
	Cl 38	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
Chromium (24)	Cr 51	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	3×10^{-3}
		I	2×10^{-6}	5×10^{-2}	8×10^{-8}	2×10^{-3}
Cobalt (27)	Co 57	S	3×10^{-6}	2×10^{-2}	1×10^{-7}	5×10^{-4}
		I	2×10^{-7}	1×10^{-2}	6×10^{-9}	4×10^{-4}
	Co 58 m	S	2×10^{-5}	8×10^{-2}	6×10^{-7}	3×10^{-3}
		I	9×10^{-6}	6×10^{-2}	3×10^{-7}	2×10^{-3}
	Co 58	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-6}	3×10^{-3}	2×10^{-9}	9×10^{-5}
	Co 60	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
		I	9×10^{-9}	1×10^{-3}	3×10^{-10}	3×10^{-5}
Copper (29)	Cu 64	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(See notes at end of appendix)

Element (Atomic Number)	Isotope		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
Curium (96)	Cm 242	S	1×10^{-10}	7×10^{-4}	4×10^{-12}	2×10^{-5}
		I	2×10^{-10}	7×10^{-4}	6×10^{-12}	3×10^{-5}
	Cm 243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	5×10^{-6}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}
	Cm 244	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
		I	1×10^{-10}	6×10^{-4}	3×10^{-12}	3×10^{-5}
	Cm 245	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Cm 246	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Cm 247	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	6×10^{-4}	4×10^{-12}	2×10^{-5}
	Cm 248	S	6×10^{-13}	1×10^{-5}	2×10^{-14}	4×10^{-7}
		I	1×10^{-11}	4×10^{-5}	4×10^{-13}	1×10^{-6}
	Cm 249	S	1×10^{-5}	6×10^{-2}	4×10^{-7}	2×10^{-3}
		I	1×10^{-5}	6×10^{-2}	4×10^{-7}	2×10^{-3}
Dysprosium (66)	Dy 165	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
	Dy 166	S	2×10^{-7}	1×10^{-3}	5×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
Einsteinium (99)	Es 253	S	8×10^{-10}	7×10^{-4}	3×10^{-11}	2×10^{-5}
		I	6×10^{-10}	7×10^{-4}	3×10^{-11}	2×10^{-5}
	Es 254 m	S	5×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-5}
		I	6×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-5}
	Es 254	S	2×10^{-11}	4×10^{-4}	6×10^{-13}	1×10^{-5}
		I	1×10^{-10}	4×10^{-4}	4×10^{-12}	1×10^{-5}
	Es 255	S	5×10^{-10}	2×10^{-4}	2×10^{-11}	3×10^{-5}
		I	4×10^{-10}	8×10^{-4}	1×10^{-11}	3×10^{-5}
Erbium (68)	Er 169	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	4×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	Er 171	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Europium (63)	Eu 152 (T/2=9.2 hrs)	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Eu 152 (T/2=13 yrs)	S	1×10^{-8}	2×10^{-3}	4×10^{-10}	8×10^{-5}
		I	2×10^{-8}	2×10^{-3}	6×10^{-10}	8×10^{-5}
	Eu 154	S	4×10^{-9}	6×10^{-4}	1×10^{-10}	2×10^{-5}
		I	7×10^{-9}	6×10^{-4}	2×10^{-10}	2×10^{-5}
	Eu 155	S	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
		I	7×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
Fermium (100)	Fm 254	S	6×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
		I	7×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Fm 255	S	2×10^{-8}	1×10^{-3}	5×10^{-10}	3×10^{-5}
		I	1×10^{-9}	1×10^{-3}	4×10^{-10}	3×10^{-5}
	Fm 256	S	3×10^{-9}	3×10^{-5}	1×10^{-10}	9×10^{-7}
		I	2×10^{-9}	3×10^{-5}	6×10^{-11}	9×10^{-7}
Fluorine (9)	F 18	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
		I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-4}
Gadolinium (64)	Gd 153	S	2×10^{-7}	8×10^{-3}	3×10^{-9}	2×10^{-4}
		I	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Gd 159	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Gallium (31)	Ga 72	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Germanium (32)	Ge 71	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}

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Element (Atomic Number)	Isotope		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
Gold (79)	Au 196	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
	Au 198	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Au 199	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	8×10^{-7}	4×10^{-3}	3×10^{-8}	2×10^{-4}
Hafnium (72)	HF 181	S	4×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
		I	7×10^{-8}	2×10^{-3}	3×10^{-9}	7×10^{-5}
Holmium (67)	Ho 166	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Hydrogen (1)	H 3	S	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		I	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		Sub	2×10^{-3}	------	4×10^{-5}	------
Indium (49)	In 113 m	S	8×10^{-6}	4×10^{-2}	3×10^{-7}	1×10^{-3}
		I	7×10^{-6}	4×10^{-2}	2×10^{-7}	1×10^{-3}
	In 114 m	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}
	In 115 m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}
	In 115	S	2×10^{-7}	3×10^{-3}	9×10^{-9}	9×10^{-5}
		I	3×10^{-8}	3×10^{-3}	1×10^{-9}	9×10^{-5}
Iodine (53)	I 125	S	5×10^{-9}	4×10^{-5}	8×10^{-11}	2×10^{-7}
		I	2×10^{-7}	6×10^{-3}	6×10^{-9}	2×10^{-4}
	I 126	S	8×10^{-9}	5×10^{-5}	9×10^{-11}	3×10^{-7}
		I	3×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	I 129	S	2×10^{-9}	1×10^{-5}	2×10^{-11}	6×10^{-8}
		I	7×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
	I 131	S	9×10^{-9}	6×10^{-5}	1×10^{-10}	3×10^{-7}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	I 132	S	2×10^{-7}	2×10^{-3}	3×10^{-9}	8×10^{-6}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	I 133	S	3×10^{-8}	2×10^{-4}	4×10^{-10}	1×10^{-6}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	I 134	S	5×10^{-7}	4×10^{-3}	6×10^{-9}	2×10^{-5}
		I	3×10^{-6}	2×10^{-2}	1×10^{-7}	6×10^{-4}
	I 135	S	1×10^{-7}	7×10^{-4}	1×10^{-9}	4×10^{-6}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
Iridium (77)	Ir 190	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ir 192	S	1×10^{-7}	1×10^{-3}	4×10^{-9}	4×10^{-5}
		I	3×10^{-8}	1×10^{-3}	9×10^{-10}	4×10^{-5}
	Ir 194	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
Iron (26)	Fe 55	S	9×10^{-7}	2×10^{-2}	3×10^{-8}	8×10^{-4}
		I	1×10^{-6}	7×10^{-2}	3×10^{-8}	2×10^{-3}
	Fe 59	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	5×10^{-5}
Krypton (36)	Kr 85 m	Sub	6×10^{-6}	------	1×10^{-7}	------
	Kr 85	Sub	1×10^{-5}	------	3×10^{-7}	------
	Kr 87	Sub	1×10^{-6}	------	2×10^{-8}	------
	Kr 88	Sub	1×10^{-6}	------	2×10^{-8}	------
Lanthanum (57)	La 140	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
		I	1×10^{-7}	7×10^{-4}	4×10^{-9}	2×10^{-5}
Lead (82)	Pb 203	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}
	Pb 210	S	1×10^{-10}	4×10^{-6}	4×10^{-12}	1×10^{-7}
		I	2×10^{-10}	5×10^{-3}	8×10^{-12}	2×10^{-4}

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Element (Atomic Number)	Isotope		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
	Pb 212	S	2×10^{-8}	6×10^{-4}	6×10^{-10}	2×10^{-5}
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}
Lutetium (71)	Lu 177	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Manganese (25)	Mn 52	S	2×10^{-7}	1×10^{-3}	7×10^{-9}	3×10^{-5}
		I	1×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Mn 54	S	4×10^{-7}	4×10^{-3}	1×10^{-9}	1×10^{-4}
		I	4×10^{-8}	3×10^{-3}	1×10^{-9}	1×10^{-4}
	Mn 56	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Mercury (80)	Hg 197 m	S	7×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-4}
		I	8×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Hg 197	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
		I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-4}
	Hg 203	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
Molybdenum (42)	Mo 99	S	7×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
Neodymium (60)	Nd 144	S	8×10^{-11}	2×10^{-3}	3×10^{-12}	7×10^{-5}
		I	3×10^{-10}	2×10^{-3}	1×10^{-11}	8×10^{-5}
	Nd 147	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	6×10^{-5}
	Nd 149	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
		I	1×10^{-6}	8×10^{-3}	5×10^{-8}	3×10^{-4}
Neptunium (93)	Np 237	S	4×10^{-12}	9×10^{-5}	1×10^{-13}	3×10^{-6}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	Np 239	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	7×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
Nickel (28)	Ni 59	S	5×10^{-7}	6×10^{-3}	2×10^{-8}	2×10^{-4}
		I	8×10^{-7}	6×10^{-2}	3×10^{-8}	2×10^{-3}
	Ni 63	S	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	7×10^{-4}
	Ni 65	S	9×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Niobium (Columbium) (41)	Nb 93 m	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
	Nb 95	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	1×10^{-7}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Nb 97	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
Osmium (76)	Os 185	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	7×10^{-5}
	Os 191 m	S	2×10^{-5}	7×10^{-2}	6×10^{-7}	3×10^{-3}
		I	9×10^{-6}	7×10^{-2}	3×10^{-7}	2×10^{-3}
	Os 191	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Os 193	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	9×10^{-9}	5×10^{-5}
Palladium (46)	Pd 103	S	1×10^{-6}	1×10^{-2}	5×10^{-8}	3×10^{-4}
		I	7×10^{-7}	8×10^{-3}	3×10^{-8}	3×10^{-4}
	Pd 109	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
Phosphorus (15)	P 32	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	8×10^{-8}	7×10^{-4}	3×10^{-9}	2×10^{-5}
Platinum (78)	Pt 191	S	8×10^{-7}	4×10^{-3}	8×10^{-7}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}

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(See notes at end of appendix)

Element (Atomic Number)	Isotope		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
	Pt 193 m	S	7×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
	Pt 197 m	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
	Pt 197	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Plutonium (94)	Pu 238	S	2×10^{-12}	1×10^{-4}	7×10^{-14}	5×10^{-6}
		I	3×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 239	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 240	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 241	S	9×10^{-11}	7×10^{-3}	3×10^{-9}	2×10^{-4}
		I	4×10^{-8}	4×10^{-2}	1×10^{-9}	1×10^{-3}
	Pu 242	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	9×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 243	S	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
		I	2×10^{-6}	1×10^{-2}	8×10^{-8}	3×10^{-4}
	Pu 244	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
		I	3×10^{-11}	3×10^{-4}	1×10^{-12}	1×10^{-5}
Polonium (84)	Po 210	S	5×10^{-10}	2×10^{-5}	2×10^{-11}	7×10^{-7}
		I	2×10^{-10}	8×10^{-4}	7×10^{-12}	3×10^{-5}
Potassium (19)	K 42	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Praseodymium (59)	Pr 142	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Pr 143	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
Promethium (61)	Pm 147	S	6×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
		I	1×10^{-7}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Pm 149	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Protoactinium (91)	Pa 230	S	2×10^{-9}	7×10^{-3}	6×10^{-11}	2×10^{-4}
		I	8×10^{-10}	7×10^{-3}	3×10^{-11}	2×10^{-4}
	Pa 231	S	1×10^{-12}	3×10^{-5}	4×10^{-14}	9×10^{-7}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	2×10^{-5}
	Pa 233	S	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
		I	2×10^{-7}	3×10^{-3}	6×10^{-9}	1×10^{-4}
Radium (88)	Ra 223	S	2×10^{-9}	2×10^{-5}	6×10^{-11}	7×10^{-7}
		I	2×10^{-10}	1×10^{-4}	8×10^{-12}	4×10^{-6}
	Ra 224	S	5×10^{-9}	7×10^{-5}	2×10^{-10}	2×10^{-6}
		I	7×10^{-10}	2×10^{-4}	2×10^{-11}	5×10^{-6}
	Ra 226	S	3×10^{-11}	4×10^{-7}	3×10^{-12}	3×10^{-8}
		I	5×10^{-11}	9×10^{-4}	2×10^{-12}	3×10^{-5}
	Ra 228	S	7×10^{-11}	8×10^{-7}	2×10^{-12}	3×10^{-8}
		I	4×10^{-11}	7×10^{-4}	1×10^{-12}	3×10^{-5}
Radon (86)	Rn 220	S	3×10^{-7}	------	1×10^{-8}	------
		I	------	------	------	------
	Rn 222	S	1×10^{-7}	------	3×10^{-9}	------
Rhenium (75)	Re 183	S	3×10^{-6}	2×10^{-2}	9×10^{-8}	6×10^{-4}
		I	2×10^{-7}	8×10^{-3}	5×10^{-9}	3×10^{-4}
	Re 186	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Re 187	S	9×10^{-6}	7×10^{-2}	3×10^{-7}	3×10^{-3}
		I	5×10^{-7}	4×10^{-2}	2×10^{-8}	2×10^{-3}
	Re 188	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(See notes at end of appendix)

Element (Atomic Number)	Isotope		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
Rhodium (45)	Rh 103 m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	6×10^{-5}	3×10^{-1}	2×10^{-6}	1×10^{-2}
	Rh 105	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Rubidium (37)	Rb 86	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	7×10^{-8}	7×10^{-4}	2×10^{-9}	2×10^{-5}
	Rb 87	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	7×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
Ruthenium (44)	Ru 97	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
	Ru 103	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	8×10^{-8}	2×10^{-3}	3×10^{-9}	8×10^{-5}
	Ru 105	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
	Ru 106	S	8×10^{-8}	4×10^{-4}	3×10^{-9}	1×10^{-5}
		I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}
Samarium (62)	Sm 147	S	7×10^{-21}	2×10^{-3}	2×10^{-12}	6×10^{-5}
		I	3×10^{-10}	2×10^{-3}	9×10^{-12}	7×10^{-5}
	Sm 151	S	6×10^{-8}	1×10^{-2}	2×10^{-9}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
	Sm 153	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Scandium (21)	Sc 46	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-8}	1×10^{-3}	8×10^{-10}	4×10^{-5}
	Sc 47	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
	Sc 48	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Selenium (34)	Se 75	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
		I	1×10^{-7}	8×10^{-3}	4×10^{-9}	3×10^{-4}
Silicon (14)	Si 31	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
		I	1×10^{-6}	6×10^{-3}	3×10^{-8}	2×10^{-4}
Silver (47)	Ag 105	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	8×10^{-8}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Ag 110 m	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	1×10^{-8}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Ag 111	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Sodium (11)	Na 22	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	9×10^{-9}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Na 24	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Strontium (38)	Sr 85 m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
		I	3×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
	Sr 85	S	2×10^{-7}	3×10^{-3}	8×10^{-9}	1×10^{-4}
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Sr 89	S	3×10^{-8}	3×10^{-4}	3×10^{-10}	3×10^{-6}
		I	4×10^{-9}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Sr 90	S	1×10^{-9}	1×10^{-5}	3×10^{-11}	3×10^{-7}
		I	5×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Sr 91	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	1×10^{-3}	9×10^{-9}	5×10^{-5}
	Sr 92	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Sulfur (16)	S 35	S	3×10^{-7}	2×10^{-3}	9×10^{-9}	6×10^{-5}
		I	3×10^{-7}	8×10^{-3}	9×10^{-9}	3×10^{-4}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(See notes at end of appendix)

Element (Atomic Number)	Isotope		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Tantalum (73)	Ta 182	S	4×10^{-6}	1×10^{-3}	1×10^{-9}	4×10^{-5}
		I	2×10^{-8}	1×10^{-3}	7×10^{-10}	4×10^{-5}
Technetium (43)	Tc 96 m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	3×10^{-5}	3×10^{-1}	1×10^{-6}	1×10^{-2}
	Tc 96	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Tc 97 m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-7}	5×10^{-3}	5×10^{-9}	2×10^{-4}
	Tc 97	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Tc 99 m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}
		I	1×10^{-5}	8×10^{-2}	5×10^{-7}	3×10^{-3}
	Tc 99	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
Tellurium (52)	Te 125 m	S	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	Te 127 m	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
		I	4×10^{-8}	2×10^{-3}	1×10^{-9}	5×10^{-5}
	Te 127	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Te 129 m	S	8×10^{-8}	1×10^{-3}	3×10^{-9}	3×10^{-5}
		I	3×10^{-8}	6×10^{-4}	1×10^{-9}	2×10^{-5}
	Te 129	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
		I	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}
	Te 131 m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
	Te 132	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Terbium (65)	Tb 160	S	1×10^{-7}	1×10^{-3}	3×10^{-9}	4×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
Thallium (81)	Tl 200	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Tl 201	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Tl 202	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	7×10^{-5}
	Tl 204	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	2×10^{-3}	9×10^{-10}	6×10^{-5}
Thorium (90)	Th 228	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
		I	6×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
	Th 230	S	2×10^{-12}	5×10^{-5}	8×10^{-14}	2×10^{-6}
		I	1×10^{-11}	9×10^{-4}	3×10^{-13}	3×10^{-5}
	Th 232	S	3×10^{-11}	5×10^{-5}	1×10^{-12}	2×10^{-6}
		I	3×10^{-11}	1×10^{-3}	1×10^{-12}	4×10^{-5}
	Th natural	S	3×10^{-11}	3×10^{-5}	1×10^{-12}	1×10^{-6}
		I	3×10^{-11}	3×10^{-4}	1×10^{-12}	1×10^{-5}
	Th 234	S	6×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	3×10^{-8}	5×10^{-4}	1×10^{-9}	2×10^{-5}
Thulium (69)	Tm 170	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
	Tm 171	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	5×10^{-4}
		I	2×10^{-7}	1×10^{-2}	8×10^{-9}	5×10^{-4}
Tin (50)	Sn 113	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	8×10^{-5}
	Sn 125	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	8×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
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Element (Atomic Number)	Isotope		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Tungsten (Wolfram) (74)	W 181	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	4×10^{-9}	3×10^{-4}
	W 185	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	W 187	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Uranium (92)	U 230	S	3×10^{-10}	1×10^{-4}	1×10^{-11}	5×10^{-6}
		I	1×10^{-10}	1×10^{-4}	4×10^{-12}	5×10^{-6}
	U 232	S	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
		I	3×10^{-11}	8×10^{-4}	9×10^{-13}	3×10^{-5}
	U 233	S	5×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	U 234	S	6×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	U 235	S	5×10^{-10}	8×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	U 236	S	6×10^{-10}	1×10^{-3}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	1×10^{-3}	4×10^{-12}	3×10^{-5}
	U 238	S	7×10^{-11}	1×10^{-3}	3×10^{-12}	4×10^{-5}
		I	1×10^{-10}	1×10^{-3}	5×10^{-12}	4×10^{-5}
	U 240	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
	U natural	S	7×10^{-11}	5×10^{-4}	3×10^{-12}	2×10^{-5}
		I	6×10^{-11}	5×10^{-4}	2×10^{-12}	2×10^{-5}
Vanadium (23)	V 48	S	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
		I	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
Xenon (54)	Xe 131 m	Sub	2×10^{-5}	------	4×10^{-7}	------
	Xe 133 m	Sub	1×10^{-5}	------	3×10^{-7}	------
	Xe 133	Sub	1×10^{-5}	------	3×10^{-7}	------
	Xe 135	Sub	4×10^{-6}	------	1×10^{-7}	------
Ytterbium (70)	Yb 175	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Yttrium (39)	Y 90	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	Y 91 m	S	2×10^{-5}	1×10^{-1}	8×10^{-7}	3×10^{-3}
		I	2×10^{-5}	1×10^{-1}	6×10^{-7}	3×10^{-3}
	Y 91	S	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
		I	3×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Y 92	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Y 93	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Zinc (30)	Zn 65	S	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
	Zn 69 m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Zn 69	S	7×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	9×10^{-6}	5×10^{-2}	3×10^{-7}	2×10^{-3}
Zirconium (40)	Zr 93	S	1×10^{-7}	2×10^{-2}	4×10^{-9}	8×10^{-4}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Zr 95	S	1×10^{-7}	2×10^{-3}	4×10^{-9}	6×10^{-5}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	6×10^{-5}
	Zr 97	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	9×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
(See notes at end of appendix)

Element (Atomic Number)	Isotope[1]	Table I		Table II	
		Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml).
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours.	Sub	1×10^{-6}	.....	3×10^{-6}	.....
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.		3×10^{-9}	9×10^{-5}	1×10^{-10}	3×10^{-6}
Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.		6×10^{-13}	4×10^{-7}	2×10^{-14}	3×10^{-8}

[1]Soluble (S); Insoluble (I)

[2]"Sub" means that values given are for submersion in a semi-spherical infinite cloud of airborne material.

APPENDIX A

NOTE: In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of this Appendix should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix "A" for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

EXAMPLE: If radionuclides a, b, and c are present in concentrations Ca, Cb, and Cc, and if the applicable MPC's are MPCa, and MPCb, and MPCc, respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{Ca}{MPCa} + \frac{Cb}{MPCb} + \frac{Cc}{MPCc} \leq 1$$

2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Appendix "A" shall be:

a. For purposes of Table I, Col. 1 6×10^{-13}
b. For purposes of Table I, Col. 2 4×10^{-7}
c. For purposes of Table II, Col. 1 2×10^{-14}
d. For purposes of Table II, Col. 2 3×10^{-8}

3. If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in paragraph 2 above.

a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration limit for the mixture is the limit specified in Appendix "A" for the radionuclide in the mixture having the lowest concentration limit; or,

b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Appendix "A" are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Appendix "A" for any radionuclide which is not known to be absent from the mixture; or,

c. Element (atomic number) and Isotope	Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
If it is known that Sr 90, I 125, I 126, I 129, I 131, (I 133, Table II only), Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th-nat, Cm 248, Cf 254 and Fm 256 are not present	.....	9×10^{-5}	.....	3×10^{-6}
If it is known that Sr 90, I 125, I 126, (I 131, I 133, Table II only), Pb 210, Po 210, Ra 223, Ra 226, Ra 228, Pa 231, Th-nat, Cm 248, Cf 254, and Fm 256 are not present.	.....	6×10^{-5}	.....	2×10^{-6}
If it is known that Sr 90, I 129, (I 125, I 126, I 131, Table II only), Pb 210, Ra 226, Ra 228, Cm 248, and Cf 254 are not present.	.....	2×10^{-5}	.....	6×10^{-7}
If it is known that (I 129, Table II only), Ra 226, and Ra 228 are not present.	.....	3×10^{-6}	.....	1×10^{-7}

APPENDIX A

Element (atomic number) and Isotope	Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not present.	$3x10^{-9}$	.....	$1x10^{-10}$	.....
If it is known that alpha-emitters and Pb 210, Ac 227, Ra 228, and Pu 241 are not present.	$3x10^{-10}$	.....	$1x10^{-11}$	.....
If it is known that alpha-emitters and Ac 227 are not present.	$3x10^{-11}$	.....	$1x10^{-12}$	.....
If it is known that Ac 227, Th 230, Pa 231, Pu 238, Pu 239, Pu 240, Pu 242, Pu 244, Cm 248, Cf 249 and Cf 251 are not present.	$3x10^{-12}$	.....	$1x10^{-13}$	.....

4. If the mixture of radionuclides consist of uranium and its daughter products in ore dust prior to chemical processing of the uranium ore, the values specified below may be used in lieu of those determined in accordance with paragraph 1 above or those specified in paragraphs 2 and 3 above.

a. For purposes of Table I, Column 1, $1x10^{-10}$ uc/ml gross alpha activity; or $2.5x10^{-11}$ uc/ml natural uranium; or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Column 1, $3x10^{-12}$ uc/ml gross alpha activity; or $8x10^{-13}$ uc/ml natural uranium; or 3 micrograms per cubic meter of air natural uranium.

5. For purposes of this note, a radionuclide may be considered as not present in a mixture if (a) the ratio of the concentration of that radionuclide in the mixture (Ca) to the concentration limit for that radionuclide specified in Table II of Appendix "A" (MPCa) does not exceed 1/10, (i.e., $\frac{Ca}{MPCa} \leq \frac{1}{10}$).

and (b) the sum of such ratios for all radionuclides considered as not present in the mixture does not exceed ¼, (i.e., $\frac{Ca}{MPCa} + \frac{Cb}{MPCb} + \ldots \leq \frac{1}{4}$).

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PART C

APPENDIX B

Material	Micro-curies	Material	Micro-curies
Ag 105	1	Pd 103+Rh 103	50
Ag 111	10	Pd 109	10
As 76, As 77	10	Pm 147	10
Au 198	10	Po 210	0.1
Au 199	10	Pr 143	10
Ba 140+La 140	1	Pu 239	1
Be 7	50	Ra 226	0.1
C 14	50	Rb 86	10
Ca 45	10	Re 186	10
Cd 109+Ag 109	10	Rh 105	10
Ce 144+Pr 144	1	Ru 106+Rh 106	1
Cl 36	1	S 35	50
Co 60	1	Sb 124	1
Cr 51	50	Sc 46	1
Cs 137+Ba 137	1	Sm 153	10
Cu 64	50	Sn 113	10
Eu 154	1	Sr 89	1
F 18	50	Sr 90+Y 90	0.1
Fe 55	50	Ta 182	10
Fe 59	1	Tc 96	1
Ga 72	10	Tc 99	1
Ge 71	60	Te 127	10
H 3 (HTO or H320)	250	Te 129	1
I 131	10	Th (natural)	50
In 114	1	Tl 204	50
Ir 192	10	Tritium. See H 3	250
K 42	10	U (natural)	50
La 140	10	U 233	1
Mn 52	1	U 234-U 235	50
Mn 56	50	V 48	1
Mo 99	10	W 185	10
Na 22	10	Y 90	1
Na 24	10	Y 91	1
Nb 95	10	Zn 65	10
Ni 59	1	Unidentified radioactive materials or any of the above in unknown mixtures	0.1
Ni 63	1		
P 32	10		

NOTE: For purposes of Sections C.203 and C.304, where there is involved a combination of isotopes in known amounts the limit for the combination should be derived as follows: determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed "1" (i.e., "unity").

EXAMPLE: For purposes of Section C.304, if a particular batch contains 2,000 uc of Au^{198} and 25,000 uc of C^{14}, it may also include not more than 3,000 uc of I^{131}. This limit was determined as follows:

$$\frac{2{,}000\text{uc } Au^{198}}{10{,}000\text{uc}} + \frac{25{,}000\text{uc } C^{14}}{50{,}000\text{uc}} + \frac{3{,}000\text{uc } I^{131}}{10{,}000\text{uc}} = 1$$

The denominator in each of the above ratios was obtained by multiplying the figure in the table by 1,000 as provided in Section C.304.